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TIMBER MANAGEMENT PLAN

SACRAMENTO WORKING CIRCLE

LINCOLN NATIONAL FOREST
Region 3
FOURTH REVISION
(F.Y. 1962 through F.Y. 1981)

U. S. FOREST SERVICE

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TIMBER MANAGEMENT PLAN

SACRAMENTO WORKING CIRCLE

LINCOLN NATIONAL FOREST
Region 3
Fourth Revision
(F.Y. 1962 through F. Y. 1981)

Approved: April 17, 1962

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C O P Y

- Forest Service
Washington 25, D. C. 2410

April 17, 1962

Regional Forester, R-3

Your Reference: 4/6

Edward P. Cliff, Chief, By

Plans - Lincoln N. F., Sacramento W. C.

Enclosed are an approved copy of this plan and our comments on it.

If available, we would like to have 10 copies (without maps) for our distribution supply. Also, we suggest that a copy be sent to each of the other Regions and to the forest schools. Since a budget is not included, it would be desirable that our comments be inserted in sample copies.

We have a request for a modern R-3 plan from L. S. Gross, so would appreciate your sending him a copy also. His address is: Box 606, Port Orange, Florida.

We heartily agree with your observation that this plan is markedly better than previously submitted plans.

Enclosures

/s/ Clare Hendee

2xc: R-3

C O P Y - Forest Service
Washington 25, D. C.

2410

The Files April 11, 1962

D. J. Morriss, Forester

Plans - R-3, Lincoln N. F., Sacramento W. C.

As stated in the Regional Forester's memorandum of transmittal, this plan is a striking improvement over past plans. It tackles realistically the severe problems presented by the poor current condition of the timber resource, sets prescriptions based on keen observation and the latest available research results, and provides for definite study and trials that are still necessary. It is a good example of charting progress without waiting for accumulation of all of the desirable base data.

Since regulation is by area it would normally be required that the summary of the plan include a statement somewhat as follows: "Regulation is by area. The periodic yield is estimated at _____MBF to be cut from _____acres to be worked over, of which _____acres will be released or reproduced. The annual average regulated acreage is _____, including _____acres of regeneration cutting." As explained on page 52 this control, including compartment establishment and a compartment entry budget, will be worked out during the plan period. Since these items are plan essentials an interim addition incorporating them should be made within the next few years.

The estimated yield is about 41.5 percent of the estimated periodic annual increment. This seems a little low but it is recognized that both estimates were developed from shaky data. Once area control is established any error which may exist will be wiped out anyhow. There is no known objective method of allocation of growth to growing stock but there is considerable past experience pointing to 50 percent as the maximum usually necessary for even completely cutover working circles.

A rotation of 200 years is adopted for the administrative working group (page 31). However, this is stated elswhere (page 29) as suggested, so presumably is open for further consideration. Taking an optimistic view of the results to be expected under the intensive treatments planned, 160 years may be adequate. This would raise average annual regeneration from 33 acres to 41 acres. While not a great change, the opportunity is an important consideration, especially since this is probably the worst dwarfmistletoe-infected area in the country. Reconsideration when the 1971 revision is made should be soon enough.

Approval is recommended. /s/ D. J. Morriss

3cc: R-3

FOURTH REVISION

TIMBER MANAGEMENT PLAN

SACRAMENTO WORKING CIRCLE

LINCOLN NATIONAL FOREST

REGION 3

1962

Prepared By:

/s/ Edgar L. Whipple, Forester

/s/ Barry R. Flamm, Forester

/s/ James W. Thorne, Forester March 14, 1962

Approved By:

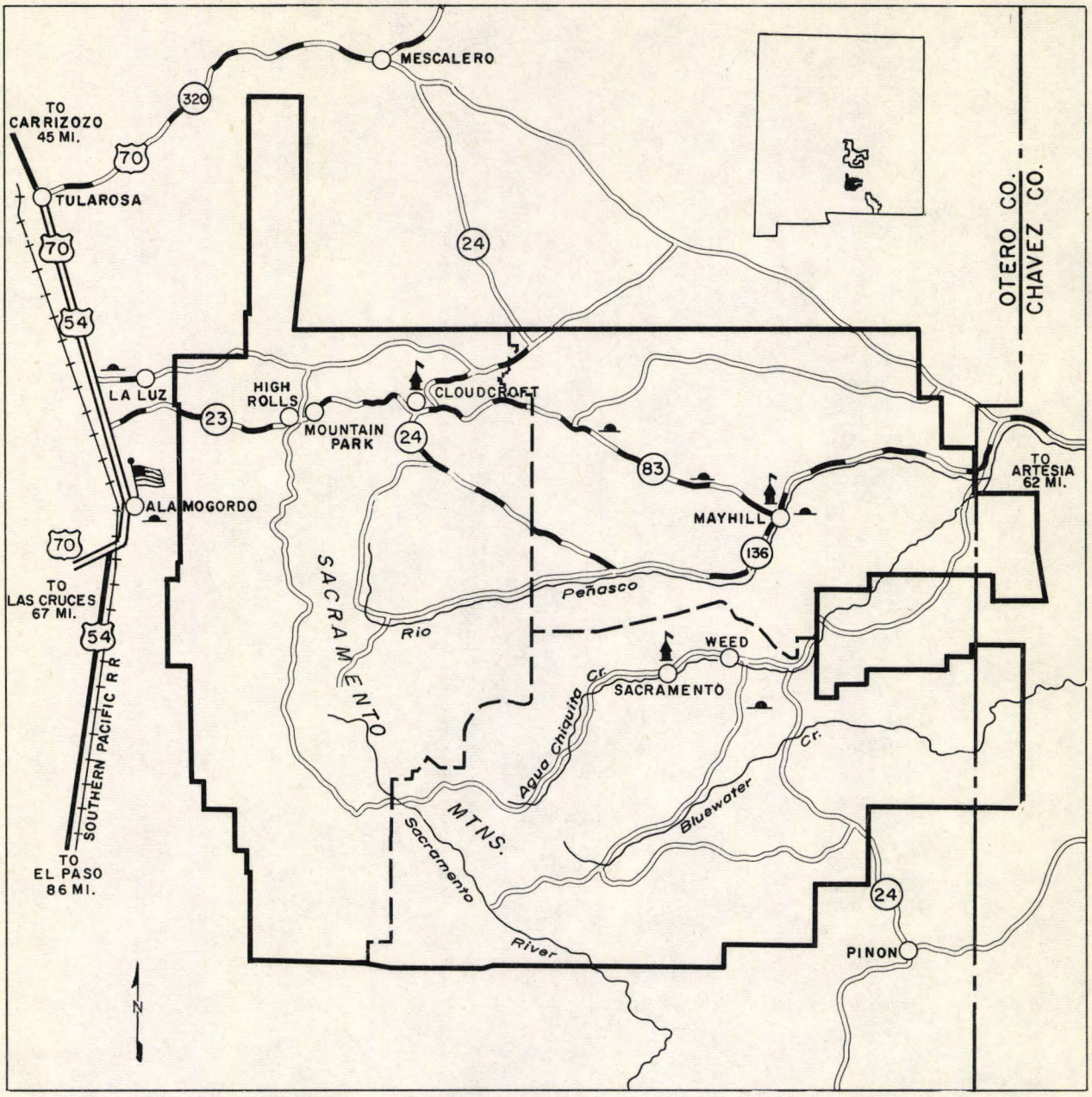
/s/ R. E. Rea March 14, 1962
Forest Supervisor

/s/ Fred H. Kennedy April 6, 1962
Regional Forester

/s/ Clare Hendee April 17, 1962
Acting Chief

Reviewed By:

Regional Office		Divisions	Washington Office	
Initials	Date		Initials	Date
/s/ DJK	4/5/62	Timber Management		
/s/ RJN	3/30/62	Engineering		
/s/ LGW	3/30/62	Multiple Use		



LOCATION MAP

SACRAMENTO WORKING CIRCLE

LINCOLN NATIONAL FOREST

R-3

Scale: 1 Inch = 7 Miles

LEGEND

- Forest boundary
- Ranger district boundary
- County line
- Supervisor's headquarters
- Ranger station
- Roads: 70 / 30 / 160 — Federal / State / Forest
- Mfg. facilities

Working circle and forest boundaries coincide unless otherwise shown

NOTE: Additional sawmill at Artesia

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II. SUMMARY OF THE PLAN

A. Management Objectives for the Working Circle

The Sacramento Working Circle consists of the southern portion of the Sacramento Mountains in southeastern New Mexico and contains the Cloudcroft, Mayhill, and Sacramento Ranger Districts of the Lincoln National Forest.

Past cutting practices were designed to maintain an all-aged timber stand over the entire working circle. Future management will be based on even-aged stands which will be cut under area controls. This plan covers the transition period from all-age to even-age stands. Management decisions herein are designed to facilitate conversion of the stand into groups with planned size-age and basal areas. Rotation period will be 120 years, and the cutting period will be 20 years.

1. The principal objective of management of the commercial forestlands in the working circle is to obtain continuous quality production at a level as high as economically practicable.

2. All multiple-use principles will be followed.

3. On the sites in the Administrative Working Group areas, the objectives are to protect, improve, harvest, and maintain stands of timber which will be adequate for the uses of the areas.

4. All denuded areas will be restocked through planting, direct seeding, or natural regeneration where possible.

5. During the first cutting period the initial harvest of all commercial, virgin timberlands will be completed.

6. The working circle will be divided into compartments of 1,000 acres or less. Each compartment will be mapped by stand age, by stand condition, and by stand site index. Silvicultural prescriptions will be prepared for each compartment.

7. Growth data will be developed for each compartment, based on stand age, on stand site index, and on stand stocking.

8. Overstocked areas will be reduced to an optimum 57% of basal area full stocking. Understocked areas will be brought to optimum stocking through growth and through planting or direct seeding.

9. Disease will be removed from the stands through cutting practices.

10. The quality of the stands will be improved through precommercial thinning and through commercial, intermediate cuts.

B. Area and Volume Data.

1. Ownership Status.

	All Lands	Commercial Forest Lands	
	Acres	Acres	Net Volume Mbf. Scribner
National Forest	434,020	204,305	543,296
State of New Mexico	42,588	---	---
Private	75,809	---	---
Total, Working Circle	552,417	204,305	543,296

2. Commercial Forest Lands - National Forest.

Technical Working Group		
Virgin	3,831	22,901.7
Cutover	129,827	446,763.2
Young Growth and Regenerating	61,070	38,932.0
	194,728	508,596.9
Administrative Working Group		
Virgin	1,047	8,390.6
Cutover	3,637	14,398.4
Young Growth and Regenerating	1,957	1,260.1
	6,641	24,049.1
Christmas Tree Working Group		
Virgin	2,936	10,650.0
Total, Commercial	204,305	543,296.0

3. Noncommercial Forest Lands - National Forest.

Inaccessible	11,458	31,365.4
Woodland	144,232	---
Total, Noncommercial	155,690	31,365.4

4. Other National Forest Lands.

Other Lands	74,025	---
TOTAL, WORKING CIRCLE	434,020	574,661.4

C. Available Cut and Cutting Limitations.

1. Available Cut from All Stands of Timber.

Annual Mbf. Scribner	10-Year Period Mbf. Scribner	20-Year Period Mbf. Scribner
9,312	93,120	186,240

2. Limitations on Cutting of Timber.

This plan recognizes that cyclic market conditions will cause fluctuations in the annual cut of timber. The annual available cut is a goal to strive for, but market conditions will determine the actual cut in any one year. Therefore, the available cut shall be balanced by 10-year periods, rather than annually. Undercuts may be made up any time during the cutting period.

D. Growth.

The periodic annual growth is 22,458 M board feet, for this cutting period. When all the commercial land is properly stocked, the potential mean annual growth is 46,917 M board feet.

E. Plan Revision.

This plan will be revised prior to June 30, 1971.

Interim revisions to the plan will be made if they are needed because of the occurrence of burns, unusual mortality of timber, changes in the utilization of products, significant changes in ownership of land, or other conditions which the Forest Supervisor shall deem to make this plan inoperable. A division of the working circle into blocks and compartments, and a budget of entry shall be added to this plan. The Forest Supervisor will have authority to make changes in the budget of entry.

F. Multiple-use Correlation.

Any conflicts between this plan and district multiple-use plans or other regionally approved resource plans must be resolved by the Regional Forester. Changes in this plan, unless specified herein, must be approved by the Chief of the U.S. Forest Service. This working circle plan will determine the management decisions and will set up the silvicultural practices to be used for the timber in the working circle.

III. INTRODUCTION.

A. The Lincoln National Forest.

The Lincoln National Forest is located in the Sacramento, Capitan, and Guadalupe mountains in southeastern New Mexico, about midway between the Pecos River and the Rio Grande. The Sacramento and Guadalupe mountains break off abruptly on the west side into the Tularosa Basin, and slope moderately toward the Pecos River on the east. The Capitan Mountains run in an east-west direction, and drain entirely into the Pecos River.

Topography and land ownership patterns divide the Lincoln National Forest into the Sacramento, the Lincoln, and the Guadalupe Divisions. The Mescalero Apache Indian Reservation separates the Sacramento Division from the Lincoln Division. The Lincoln Division occupies the Capitan Mountains and the north end of the Sacramento Mountains.

B. The Sacramento Working Circle.

The Sacramento Division of the Lincoln National Forest occupies the southern portion of the Sacramento Mountains; the entire division is the Sacramento Working Circle. This working circle is divided into three Ranger Districts: Cloudcroft, Mayhill, and Sacramento.

1. History of the Sacramento Working Circle.

Part of this working circle was temporarily withdrawn for Forest Reserve purposes as early as 1893, but it later was restored to the public domain. Immediately following this restoration, such heavy State selections and other alienations of timberland were made as to result in an unfavorable consideration of the Sacramento Mountains for forest withdrawal at a later date. Subsequent to this, in 1905, by House Concurrent Resolution Number 18, adopted by the Texas Legislature, the Federal Government was petitioned to protect the watershed of the Pecos River by setting aside areas in the Sacramento and Guadalupe Mountains as a Forest Reserve. This resolution was forwarded to the Forester in May, 1905. As a direct result of this, a part of the Sacramento Division was withdrawn for forest purposes on April 24, 1907, as the Sacramento National Forest. In 1908, this forest was consolidated with the Guadalupe Forest under the name of the Alamo Forest. In 1917, the Alamo Forest and the Lincoln Forest were consolidated as the Lincoln National Forest.

2. Timber Management Plans for the Working Circle.

A Timber Management Plan for the Sacramento Mountain Working Circle was approved in March, 1926. Another plan was approved in 1941, and was revised in 1948. Since the 1948 revision, several changes have occurred in ground conditions which affect timber management. These changes are discussed below.

3. Changes in Ground Conditions Since the Third Revision of Plan in 1948.

a. Fire.

The Allen Canyon Fire in 1951 burned 15,820 acres. The Circle Cross Fire of 1953 burned 25,874 acres, and the Pendleton Fire of 1956 burned 5,825 acres. In these fires, nearly 30,000 acres of timberland were denuded totally. This causes two major problems of erosion and stand regeneration.

b. Land Exchanges.

Several land exchanges with the State of New Mexico have been consummated since the 1948 revision of the plan. Most of this area was cut heavily, prior to acquisition by the Forest Service. This land will contribute little, if any, timber during the next two or three cutting periods.

c. Timber-right Cutting.

Timber-right harvests were completed in 1960. Much of this area was subjected to extremely heavy cutting. Regeneration is expected to be a problem, since reserve volumes are almost nonexistent in places.

d. Military Withdrawals.

The Solar Furnace site, Sac Peak, and McGregor Range military withdrawals total 25,868 acres. The Forest Service has the right to manage the first two areas, but plans for harvesting of timber and other management practices must be carried out in such a manner as to cause little or no interference with military objectives. Little, if any, timberland is on the McGregor Range withdrawal, so no problem is anticipated.

e. Recreation Use.

Increased recreation use has created a problem in timber management practices. Within camp and picnic grounds, along scenic strips, and in organization buffer zones, timber will be handled on a group selection system during the first cutting period. A lengthened rotation system will be used. There will be intensive clean-up of slash on these areas. Harvesting must be done at a time when recreation activities are at a low ebb.

IV. SUMMARY OF RESULTS UNDER PREVIOUS PLANS.

A. The Timber Management Plan of 1926.

The 1926 plan called for a 160-year rotation, and cutting cycles of 20, 60, and 80 years. Allowable annual cut was estimated at 22 MM board feet on National Forest, State, private, and Indian lands. The cut on National Forest lands was estimated at 5.2 MM board feet. Apparently, the major problem was control of the cut on ownerships other than National Forest land. Results, under this plan, appear inadequate, since the entire area has been cut in 35 years, rather than being cut in the contemplated 60 years. This is apparently because of timber-right cutting, and because of losses from large fires.

B. Second TM Plan Revision of 1941.

The 1941 plan called for a 150-year rotation and 50-year cutting cycles. A large portion of the virgin, mixed-conifer timber was held as base for land-for-timber exchanges. An allowable annual cut was established for 1.5 MM board feet in the ponderosa pine type. Apparently this policy was successful.

C. Third TM Plan Revision of 1948.

One condition which prompted the 1948 plan revision was the land exchange program which reached the stage where withholding large blocks of timber was no longer necessary for exchange purposes.

The 1948 plan revision selected a 150-year rotation and 20-year cutting cycles. The allowable annual cut was calculated at 6,829 M board feet. Intermediate harvests were planned for cutover land. Future harvests were to be based on annual yield. Apparently the desired cut was achieved until large fires caused emergency salvage cuts in 1953, 1954, and 1956.

1. Annual Cuts of Timber, 1951 to June 30, 1961.

Calendar Year	Mbf. Scribner
1951	6,447
1952	6,563
1953	15,875
1954	14,810
1955	6,253
1956	8,467
1957	6,593
1958	4,615
1959	4,780
1960	4,585
To June 30, 1961	1,499
Total	80,487

2. Comparison of Third Revision of Plan, 1948, with this Fourth Revision, F.Y. 1962.

	Third Plan Revision (1948)	Fourth Plan Revision (F.Y. 1962)
Commercial Forest Lands, M Acres	135.6	204.3
Net Volume MMbf., Commercial Forest Lands	336.9	543.3
Volume per Acre, Mbf.	2.48	2.66
Available Annual Cut, MMbf.	6.4	9.3
Available Annual Cut in Percent of Inventory	1.9	1.7
Rotation, Years	150	120
Cutting Period, Years	20	20

3. Changes in Acreage.

The large increase in acreage is due to the acquisition of State and private lands during the period since 1949.

4. Changes in Volumes.

The net volume and the volume per acre differences result from closer typing of the working circle, from additional growth, and from greater intensity of inventory. The difference is even more striking when it is understood that about 30,000 acres of nonstocked burns are included in the F.Y. 1962 figures. Methods of determining the volumes for the 1948 revision of plan are unknown.

5. Changes in Available Cut.

The increase in available cut is possible because of the increased acreage and volumes per acre. A deliberate attempt was made to keep the annual growth and net volume estimates on the conservative side.

6. Changes in Rotation.

A technical rotation of 120 years is selected in lieu of the 150-year rotation of the 1948 plan because available information indicates this is approximately the age of culmination of mean annual increment of the stand.

V. GENERAL DESCRIPTION OF THE SACRAMENTO WORKING CIRCLE.

A. Location.

The Sacramento Working Circle covers the south end of the Sacramento Mountains. These are uplift mountains with a steep west face and a gently sloping east face. Both faces are cut by deep, crooked drainages. The mountain crest lies in a north and south direction. Elevations range from about 4,400 feet to 9,600 feet. The sawtimber types begin at about 6,500 feet. The area to the east of the crest drains into the Pecos River and the Rio Penasco. The west slope drains into the Tularosa Basin.

Geologically, the Sacramento Mountains are an anticlinal uplift of massive, carboniferous limestone with a pronounced eastward dip. The soils are a rich clay loam, the residue from the disintegration and the decomposition of the limestone bedrock. The soils are subject to severe erosion when they are not protected adequately by vegetation. On many of the steeper slopes, the shallow soil is of insufficient depth and quality to store adequate water within reach of plant roots. On such sites, sawtimber is poor in quality, or is absent. On the more gentle slopes, especially on north and east exposures, the soil is deeper and better protected. Heavy stands of timber occur on these slopes. In the narrow, alluvial valleys the soil is deep, rich, and untimbered, and is used for agriculture and grazing. This soil is also subject to extreme erosion. The soil is the key to raising timber, forage, and crops; therefore, soil protection and maintenance of an adequate ground cover are the top priorities in the management of the timber resource.

The climate of the working circle is characterized by wet summers and winters, although both snowfall and rain are quite erratic. It is dry in the spring and fall. The precipitation will average over 20 inches annually within the sawtimber types. The majority of the total precipitation falls as summer rains in July, August, and September. The remainder falls as snow during winter months. The working circle is subject to jet-stream winds in the spring. This results in high evaporation and in occasional severe windthrow losses.

B. Stand Characteristics

1. Ponderosa Pine Type

The ponderosa pine type comprises 40% of the commercial forest land on the Sacramento Working Circle. This type contains the following species by percent of total stand volume: ponderosa pine, 64%; Douglas-fir, 35%; and limber pine, 1%.

On the west side of the working circle, the pine type begins at 7,200 feet elevation on north and east exposures, and at 7,500 feet on south and west exposures. In canyons and on north exposures, the type merges with the mixed-conifer type between 7,500 and 7,800 feet. The influence of Gulf storms, the topography, and the soils permit the pine type to grow as far down as 6,500 feet elevation on the east side. On the east side, this type merges with the mixed-conifer type at 7,200 feet on north exposures and at 8,000 feet on south exposures.

Site index ranges from 70 on rocky south slopes at lower elevations, to 90 on the north slopes at higher elevations and on alluvial bottoms.

Dwarfmistletoe is present throughout the stand and is causing considerable increment loss through mortality and reduced growth.

Much of the type is overstocked and needs thinning.

2. Mixed-conifer Type

The mixed-conifer type is the most extensive and important type of the working circle. It comprises 59% of the commercial forest land. This type contains the following species by percent of total stand volume: ponderosa pine, 15%; Douglas-fir, 40%; white fir, 31%; limber pine, 11%; and Engelmann spruce, 3%.

Except for a small area of spruce-fir type, the mixed-conifer type covers the entire top of the Sacramento Mountains. This type merges with the pine type to the east and west.

One-seeded juniper and Alligator juniper grow in association with this type over most of the area.

Dwarfmistletoe is the most damaging agent to ponderosa pine in this type. Douglas-fir is infected also by a species of dwarfmistletoe which causes some direct mortality. However, dwarfmistletoe on Douglas-fir is not considered to be as important as that on the ponderosa pine.

Site Index in this type is believed to vary from 90 to 100.

Much of this type is also in need of thinning.

3. Spruce-fir Type

The spruce-fir type is small in area. The potential production of this type is large. It is claimed that as much as 60 M bd. ft. per acre have been cut from portions of this type.

This type lies at about 9,500 feet elevation to the west of Lightning Lake and in the head of Scott Able drainage.

All of the spruce-fir type has been cut, under various cutting rights programs. However, the stand has restocked satisfactorily.

This type contains the following species by percent of total stand volume: Douglas-fir, 30%; white fir, 13%; and Engelmann spruce, 57%.

4. Aspen Type

The aspen type consists of 7,982 acres which lie mostly within the mixed-conifer type. Acreage of this type has been included in acreage figures of the major type in which it falls. This was done because the aspen is a temporary type and, on this working circle, occurs in relatively small areas. This type consists of a trace of ponderosa pine, 27% Douglas-fir, and 73% white fir.

VI. PEOPLE AND THE FOREST.

In the immediate vicinity of the working circle, the economy is based primarily on military installations, recreation, timber, and agriculture.

The forest is essential to the economy of the area in all of the above aspects. The military installations depend upon the forest for a large portion of their water supply, for recreation, and for sites for research and communication.

The 1960 census reported 36,976 people living within Otero County. Nearly 22,000 people live in Alamogordo, 3,200 at Tularosa, and 6,600 at Holloman Air Force Base. Most of the remaining 5,000 live within the forest boundary and are dependent upon recreation, timber, agriculture, or grazing for their livelihood.

There are 133 grazing permits within the Working Circle. There are 4,440 cattle and 148 sheep that graze at least part of the year.

There were nearly a million recreation visits to the Lincoln National Forest in 1960 and this use is increasing continually. An estimated two and half million visits are expected by 1976. Within the working circle, there are six camp and picnic areas which receive almost constant use from May through September, and during big game hunting seasons. These developed areas are crowded on normal weekends, and they cannot begin to handle the load during peak periods. The overflow from the campgrounds puts heavy use in undeveloped areas for camping and picnicking.

Five sawmills, with an annual capacity of 6,000 M board feet, operate within the working circle. These sawmills are important to the local economy.

The Mescalero Apache Indian Reservation also contributes to the economy of Southern New Mexico. During the period 1955 to 1960 the cut averaged approximately 8,000 M board feet annually.

The forest is essential to individuals and communities within and adjacent to the working circle, as it produces water for domestic, industrial, and irrigation purposes.

The working circle contains one of the largest deer herds in New Mexico. In 1959, thirteen thousand, four hundred hunters harvested 6,500 deer. The Game Department estimated that there was a deer population of 21,000 head on the working circle in the spring of 1960.

VII. THE OVERALL PROBLEMS AND OBJECTIVES OF FOREST ADMINISTRATION.

A. Timber.

The objectives of management of the commercial forest lands in the working circle are to obtain continuous production of timber at a level as high as economically practicable, while giving consideration to both quantity and quality, and also to operate in accordance with the principle of multiple-use.

To accomplish these objectives, timber management on the working circle involves:

1. Maintaining a current inventory of the land and timber resources, and of timber growth rates on the working circle.

2. Preparing and revising practicable Timber Management Plans for the working circle. These plans will be correlated with other uses by modifying them where necessary to meet approved land-use policies and plans. The Timber Management Plans will include calculations of available cut, sustained-yield capacity, and a periodic cutting budget.

3. Developing and maintaining a complete transportation system for the working circle.

4. Marketing the available cut of the working circle.

5. Using, on each timber sale, only approved silvicultural and utilization practices which are designed to maintain the highest practicable level of production.

6. Obtaining prompt and complete regeneration, as needed, on cutover areas.

7. Reforesting burned areas and other nonstocked or poorly stocked areas.

8. Maintaining proper stocking and growing conditions in young stands by use of timber stand improvement measures.

9. Reducing hazards of loss caused by animals, fire, wind, insects, or disease, through proper silvicultural practices, and, where necessary, by direct control.

10. Salvaging losses where possible.

A system of even-aged management regulated by area control offers the best means of accomplishing these objectives. Even-aged management offers advantages in regeneration, in less disturbance of site, and in ease and economy of planning and management on timberlands.

B. Recreation.

The increase in recreation use and the corresponding increase in value of lands suitable for recreation use have had and will continue to have an impact on the type of management which can be practiced. Within the sawtimber type, 614 acres are on administrative sites, 227 acres are within developed campgrounds, and 3,925 acres are along present or proposed scenic strips or are in the recreation buffer zone of the Potato Canyon Boy Scout Organization Site. These areas, and the Cloudcroft Experimental Forest, simply cannot be excluded from timber management, since their value is related to the forest cover on the areas. Timber harvest on the Experimental Forest must be done in cooperation with the Rocky Mountain Forest and Range Experiment Station.

On recreation areas, the objectives are to protect, improve and maintain stands of timber which will be adequate for the recreation uses to be made of the area. Reference FSH 2312.32.

C. Special Land Uses.

Special land uses, such as for military installations, power lines, pipelines, highway rights-of-way, and radio sites, will continue to take land out of timber production. All possible effort must be made to limit the area size of these uses and to divert them to other sites which have lower timber producing capabilities.

D. Watersheds.

The entire forest is composed of watersheds. Water quality and production have long been two of the major objectives of forest management. It has been recognized by legislation, that fluctuations in stream-flow are related to timber cutting practices in the forest. It is also recognized that sedimentation in streams is related to the removal of vegetative cover. The forest is the prime protector of water quality, and actually a builder of soils.

The forest manager must use any information that will aid him to weld the practice of forest management with the science of watershed management.

The delineation of regeneration areas should be such that watershed values are protected. Soil disturbance necessary for the regeneration of trees must be allowed for the increased benefit derived from the resulting timber stand. This soil disturbance must be done in a manner that will minimize soil losses. On devastated areas, burns, etc., vegetative competition will be eliminated either by removal in strips placed on contour, or by removal on larger areas where the disturbed soil will be terraced by contour plows.

Logging damage must be minimized by properly locating roads and skid trails. Check dams will be built and other engineering erosion-control measures will be applied. Vegetative cover of browse and grass species will be renewed by seeding on all but regeneration areas.

Erosion-control problem areas will be mapped, and erosion-control treatment will be prescribed at the time of presale prescription.

Special measures for erosion-control in connection with logging will be included in timber sale contracts.

E. Grazing.

Even-aged management of timber, with large regeneration areas, offers the best opportunity for maximum use of a large proportion of the forest for grazing. At first trial of this method of management, cattle should be excluded from the regeneration area. On 120-year rotation, there will be exclusion of grazing on a maximum of 5% of the forest area during any one year, through the use of a closure period of six years until establishment of the seedlings. It is entirely probable that this exclusion area can be reduced. It is also possible to handle the grazing by reduction in numbers of grazing livestock, or other means.

The Division of Wildlife and Range Management must handle control methods. Timber Management division can furnish fencing, and must consider grazing when delineating regeneration areas.

Specific regeneration areas will be delineated in the presale prescription.

Timber stand improvement measures such as thinning, and improvement cutting, should produce conditions which are favorable for growing increased cattle and game forage on remaining areas.

F. Wildlife.

The large burns have become the winter habitat of deer because of an increase of browse species. As long as the deer concentrate in these areas, they will hinder the establishment of timber regeneration.

The deer population should be reduced to a reasonable level by directing hunters to areas where tree planting has been completed, by advocating special hunts, or by other means.

It is felt that conversion of the forest to even-aged stands will be of benefit to deer and other wildlife, since openings in the canopy will be created constantly. This method of management will produce adequate openings for wildlife habitat.

Aspen stands shall be provided for aesthetic value as well as for deer food. This must be considered in presale prescriptions.

Slash should be left intermittently for nesting, and for cover for birds and small game.

To provide aspen-sprouting on logged areas, dozers that clean up slash should be altered by adding rake teeth that will cut roots. ??

Turkey nesting areas should be marked on maps as found by timber markers, so that logging can be deferred in nesting areas until after the nesting season.

Browse species, as well as grass, should be seeded on skid trails.

Timber cutting and precommercial thinning projects should be directed to areas of heavy deer concentration so as to increase forage production.

Squirrel trees that are used season after season will be left by timber markers unless the trees are insect infested, diseased, or poor risks.

G. Regeneration.

Regeneration of devastated areas is the highest priority problem of timber management on the working circle. Nearly 30,000 acres are in need of artificial regeneration during the present cutting cycle. Reproduction is difficult in these areas because of changes in the microclimate, and the lack of seed sources. To establish reproduction on these areas, it will be necessary to control rodents prior to seeding or planting and to control livestock and deer as outlined in Paragraph E., Grazing, and F., Wildlife, above.

H. Fire.

Intensive presuppression and suppression measures must be continued and improved. Costs of controlling large fires and of rehabilitating burned areas, are constantly increasing and these costs plus the loss of the basic resources involved indicate that we cannot afford to have large fires. The Timber Resource Review indicates a shortage of timber by the year 2,000, and every acre of timberland that is destroyed will aggravate this shortage. Funds that are spent for hazard reduction and fire prevention undoubtedly will pay dividends up to some point which must be determined administratively. (See X., F., Table 20.)

I. Slash Disposal

Slash dispoasl will consist of clean-up of roadside zones where fires are likely to start, and clean-up in planned fire breaks, by piling and burning. In other areas, slash will be used to plug gullies, to provide shade and protection for regeneration, and to provide for wildlife benefits.

Slash disposal practices will be coordinated with hazard reduction and thinning operations. Slash will be treated so as to aid in control of endemic insect populations. This practice is believed to be most important in spruce stands.

Recreation areas and zones will receive complete clean-up of slash.

J. Insects and Diseases

Intensive forest management will produce healthier, more vigorous trees that are able to better withstand insects and disease.

Forest personnel must be alert to detect any apparent outbreaks of insect infestation or disease, and to take any necessary control measures. Key District personnel will be trained to detect insect and disease symptoms.

K. Dwarfmistletoe

Dwarfmistletoe is probably the largest cause of mortality in ponderosa pine and Douglas-fir stands. "A Survey of Dwarfmistletoes in Arizona and New Mexico," by Stuart R. Andrews and John P. Daniels [1], indicated the problem on the Lincoln National Forest was the worst in the region. On the adjacent Mescalero Apache Indian Reservation, studies indicated that the proportion of ponderosa pine gross volume in dwarfmistletoe-infected trees ranged from 19% to 62%, with an average of 37%. [6]

Usual control methods consist of removing all trees infected with mistletoe, with periodic follow-up cuts to catch later infections. The application of usual control methods to the working circle would result in virtual clear-cutting of all age-classes of ponderosa pine, plus heavy inroads into Douglas-fir growing stock. About 60,000 acres of timberland would be taken out of harvest production for the next five or six cutting periods.

The only alternative appears to be willingness to accept some mortality loss and reduced increment by proceeding with planned conversion of stands to even-aged stands. Marking guides for timber harvests and thinning operations will stress removal of infected stems. Intermediate harvest cuts will be made to capture mortality. At the end of planned rotation, dwarfmistletoe should be eliminated from the stand, through the use of cutting practices alone.

Intensive dwarfmistletoe control programs will be used to keep regeneration areas free from the parasite.

[1] Superscripts refer to similarly numbered entries in the Bibliography.

L. Animal Damage.

At the present time, no special control measures for porcupines are needed. However, porcupine population should be watched closely. Special control measures will be initiated when and if needed.

Squirrel damage is insignificant at this time.

Deer and domestic stock damage to reproduction has been discussed previously in this section, under Paragraph E., Grazing, and F., Wildlife.

The major animal damage is that done by gophers, mice, and rats, in regeneration areas. An intensive treating program in cooperation with the U. S. Fish and Wildlife Service is urgently needed. ???

M. Small Products.

Past cutting practices have resulted in a preponderance of pole-sized trees, over much of the working circle. Thinnings are needed to reduce stands to desired basal areas. However, precommercial thinning costs are high and the present market for small products is limited. The only present small-products market is for Christmas trees and wildings. As far as possible, sales for Christmas trees will be made before areas are precommercially thinned.

It is essential that a market for small products be developed. Local timber users should be encouraged to develop ways and means of utilizing small products. To encourage the use of small products, future sales contracts should specify that trees of less than 12" d.b.h. may be marked for sawlogs if so requested by the purchaser. At the present time, at least one operator is purchasing 8" - 11" poles from private land for use as sawlogs.

A limited local market also exists for ties which could be produced from small sawlogs and poles. Special pole sales will be made in stands which need thinning, if the opportunity presents itself.

VIII. REGULATION OF TIMBER CUT.

A. System of Management.

The even-aged system is adopted for the Sacramento Working Circle. Regulation is by area for each of the three recognized working groups: 1. Technical Working Group; 2. Administrative Working Group; 3. Christmas Tree Working Group.

1. Technical Working Group.

The Technical Working Group is the major working group and is composed of the mixed-conifer type, the ponderosa pine type, and the spruce-fir type.

a. Mixed-conifer Type and Spruce-fir Type.

Cutting period	20 years
Rotation period	120 years
Rotation age	110 years
Number of age-classes	Six
Total area	115,335 acres
Regeneration area, each cutting period	19,223 acres
Regeneration area, annually	962 acres

Distribution of Mixed-conifer and Spruce-fir Stands by Size and Condition Classes.
(Aspen included in proper classes as a mixed-conifer stand.)

Size	Condition Class	Mixed-conifer Acres	Spruce-fir Acres
---	Nonstocked	7,548	18
Reproduction	Cutover	352	
Poles	Virgin	1,150	
Poles	Cutover	16,610	
Sawtimber	Virgin	2,607	
Sawtimber	Cutover	85,420	1,630
Total		113,687	1,648

During this 20-year period, the regeneration areas will be provided by 7,566 acres of denuded areas, 352 acres of present reproduction, and 11,305 acres of poorly stocked sawtimber area. Annual regeneration on denuded areas averages 378 acres which will have to be planted or direct-seeded annually. To allow for natural regeneration, reproduction cuts will be made on an annual average of 566 acres of poorly stocked sawtimber.

b. Ponderosa Pine Type.

Cutting period	20 years
Rotation period	120 years
Rotation age	110 years
Number of age-classes	Six
Total area	79,393 acres
Regeneration area, this cutting period	21,668 acres
Regeneration area, annually, this cutting period	1,083 acres
Regeneration area, subsequent cutting periods	13,232 acres
Regeneration area, annually, subsequent cutting periods	662 acres

Distribution of Ponderosa Pine stands by Size and Condition Class.

Size	Condition Class	Acres
---	Nonstocked	21,668
Reproduction	Cutover	16
Poles	Virgin	1,489
Poles	Cutover	12,219
Sawtimber	Virgin	1,224
Sawtimber	Cutover	42,777
Total		79,393

During this 20-year period, the regeneration areas will be provided by 21,668 acres of devastated areas. This is an average of 1,083 acres per year -- more than twice that needed for even-aged management age-class distribution. However, the entire devastated area should be regenerated within this cutting period. The surplus age group may be harvested at less than rotation age, or may be carried over into the next rotation, depending on ground conditions at that time.

2. Administrative Working Group.

The Administrative Working Group is composed of roadside zones, waterfront zones, administrative sites, recreation areas, and the Experimental Forest.

On the areas classified for recreation use, timber should be managed so that it will provide a pleasing forest setting. This can be attained by managing the stands for varied age-classes. Also, this type of management will provide for continuous replacement by vigorous trees capable of withstanding insects, disease, and soil compaction. Commercial sales, insofar as possible, will be used to harvest safety-hazard trees, and sanitation and risk trees, as the initial period cut.

If necessary, regeneration will be done by planting, by direct seeding, or by other methods, to secure the stocking needed for recreation purposes.

Young stands will be thinned, to promote rapid growth and large trees for aesthetic purposes. These young, vigorous trees will thus replace the diseased and decrepit monarchs which are often threats to public safety.

Harvest of rotation-age trees during succeeding cutting periods will provide for orderly replacement. (Rotation-age should be established in management plans, and 200 years is suggested for coniferous stands.)

The cutting period, for the purpose of organization, is established at 20 years. Intermediate selective removals may be made as necessary to salvage mortality, until the desired distribution of age-classes is present. Junipers, pinyon, and hardwoods will be exceptions to rotation planning.

a. Stands on sites and/or areas reserved and developed for intensive recreation use: Planners of the divisions of Timber Management and Recreation and Lands Management will jointly prepare an action plan to provide replacement trees for recreation use areas. Eighty years of optimum growth will be needed to culture trees to a size desirable for recreation purposes. Therefore, the plan will be made from an inventory in which trees needed for aesthetics will be identified for cutting in each of the next four cutting periods of 20 years.

All trees above the 120-year age-class will be so identified, in addition to safety-hazard trees, and sanitation and risk trees. Trees below the 120-year age-class can be considered as replacements, if they are healthy and are either free to grow, or can be released. The plan will make provisions for thinning, pruning, and planting to culture desirable replacements.

Pruning will often require special criteria and techniques. Pruning for stand sanitation will be done as required to maintain a healthy, productive stand. Other pruning should be done on a plan-wide basis in order to tain a variety of views, or for other purposes of recreation and timber resource management.

b. Stands on sites and/or areas designated for recreation but not yet developed: These are potential sites and areas which should be treated by commercial sales at the earliest opportunity. The desired stand-age at time of development for recreation should be 120 years and younger, with distribution through the younger age-classes. Therefore, new recreational developments should be made in stands 120 years of age and younger, or if at all possible, stands will be cut through commercial sale procedures prior to recreational development.

c. Stands on lands designated for near-natural recreation management, such as buffer zones, roadside zones, and water-front zones, where cutting is permitted: Area regulation is the desirable management system to use. The objective will be to maintain a normal distribution of age-calsses. The optimum situation would be to have one-tenth of such recreation land in each of the 20 year age-classes, using a 200-year rotation and 20-year cutting periods. This will require timber-type classification of the stands by age-classes. Once the type and area by age-class are known, management should be aimed toward making up any deficiencies in the age-classes. At the same time, each stand should be treated according to its silvicultural needs.

Silvicultural treatments will be:

(1) Artificial regeneration where necessary to complete the stocking needed for recreation purposes.

(2) Thinning, to culture younger age-class trees into large size trees. Thinning to open up the roadside screen and give depth to the view under crowns of existing trees.

(3) Removal of safety-hazard trees, and sanitation and risk trees.

(4) Harvest-cut, either singly or in groups, trees that are over rotation-age. This will release younger stands, create openings of a fraction of an acre where regeneration is needed, and will provide for orderly replacement by younger age-classes.

/Treatments (2), (3), and (4) should be done in the non-recreational season./

The remaining forested lands not specifically designated for recreation purposes receive more recreation visits than any others for purposes of viewing fall coloring, for hunting, fishing, and enjoying the forest environment. All pre-sale prescriptions should consider aesthetics such as the reservation of some aspen stands on hillsides, the arrangement of regeneration areas, the protection of meadows, the reduction of roadside logging slash and debris, and similar practices. Cutting within the experimental forest must have the approval of the Rocky Mountain Experiment Station.

Cutting period	20 years
Rotation age	200 years
Number of age-classes	10
Total area	6,641 acres
Regeneration area, each cutting period	664 acres
Regeneration area, annually	33 acres

3. Christmas Tree Working Group.

This working group is made up of 2,936 acres located in Bluewater Canyon. The unit has been selected for Christmas tree production to allow for administrative study. This study is designed to answer problems in mixed-conifer regeneration, as well as those related to the development of better-quality short-rotation products.

The area will be prepared by cutting. However, seed trees will be left at the rate of 10 to 15 per acre. These seed trees will be well spaced so as to allow adequate coverage during seed-fall.

Douglas-fir and white fir will be favored. Christmas trees will be the major product harvested but seed trees will be harvested as sawtimber. Provisions must be made for replacement of seed trees.

This area also may be a source of transplants which may be used for reforesting denuded areas.

During any cutting period, this area can be added to the mixed-conifer type as a regeneration area if the objective of the area is changed to sawtimber management.

B. General Prescription of Timber Management.

In applying the even-aged system to the Sacramento Working Circle, the working circle will be divided into compartments of approximately 1,000 acres. A silvicultural prescription will be made before entering the compartment for treatment.

1. Methods of Cutting. - seed Tree

Cutting will be in three phases: Intermediate Cuts, Regeneration Cuts, and Removal Cuts.

a. Intermediate Cuts.

Intermediate cuts are defined as repeated periodic cuts in stands which are below rotation age, and are cuts which remove and utilize a portion of the stand. Any intermediate cut may include one or more of the following:

(1) Sanitation cut to remove trees which are infected with disease or infested by insects.

(2) Salvage cut to remove merchantable dead or dying trees.

(3) Risk cut to remove trees which are likely to die before the next periodic cut.

(4) Improvement cut to remove less desirable species and trees of poor form, and trees of poor genetic characteristics

(5) Thinning cut to improve growth rate in residual stand.

b. Regeneration Cuts.

Ideally, regeneration cuts should be made on one-sixth of the total area of commercial operable timberlands during each cutting period. Under this system, 10 to 14 seed trees per acre should be left until satisfactory regeneration is established. Mixed Con 9 7 7

Ordinarily, the regeneration areas will be in blocks of 100 to 500 acres, but the size and shape will be governed by ground conditions, by topography, and by multiple-use objectives.

c. Removal Cuts.

Removal cuts will consist of the harvest of seed trees in regeneration areas after adequate reproduction has become established on these areas. Establishement of reproduction will probably take place within ten years after the regeneration cut.

d. Timber Stand Improvement.

The objectives of timber stand improvement will be:

(1) To remove mistletoe from reproduction in regeneration areas.

(2) To remove mistletoe from sapling stands and other stands below rotation age but not to reduce basal area by more than 30% of the objective set in thinning guides.

(3) To thin sapling and pole stands precommercially to an objective basal area. This will be done in stands which cannot be treated by commercial improvement cuts.

(4) To regenerate artificially, nonstocked and poorly stocked areas through the use of adequate site preparation, animal control, and planting or seeding.

(5) To prune, but this can be done only after consideration of thinning needs, site potential, and other practical aspects of forest management.

2. Available Cut.

The total regulated cut for this period is summarized below.

a. Technical Working Group.

	Bd. ft., Scribner
Cutover mixed-conifer stands	164,124,032
Cutover pine stands	3,263,803
Virgin mixed-conifer stands	11,937,752
Virgin pine stands	948,345
Total	180,273,932

This will result in an annual available cut of 9,014 M bd. ft.

(See X., D., for information on available cut calculations.)

b. Administrative Working Group.

The pathological rotation for this working group will result in extremely light cuts -- probably only 10 percent of the net sawtimber volume. However, on the assumption that the Rocky Mountain Forest and Range Experiment Station will want the experimental forest subjected to a regular harvest cut, and that the recreation buffer zone in Potato Canyon will be harvested with a group selection cut, these areas are figured separately. Results are summarized below:

Area	Total Net Volume	Estimated % Cut	Estimated Cut for Period
Recreation use areas	7,244,830	10	724,483
Experimental Forest	10,683,476*	25	2,670,869
Potato Canyon	7,338,965	35	2,568,638

* Includes growth estimates.

This will result in an annual cut of 298 M bd. ft.

c. Total Available Annual Cut.

The total available annual cut will be 9,312 M bd. ft. However, regeneration cutting and silvicultural needs will be the determining factors of cut.

Trees below the 12" d.b.h. that are cut will be in addition to available annual cut.

d. Christmas Trees.

In addition to the above, it is estimated that 1,000,000 Christmas trees can be harvested annually. (See X., E.)

C. Growth.

1. Mean Annual Increment.

The potential mean annual growth for this working circle is 46,917 M bd. ft., Scribner. This potential growth should be realized when all the commercial forest land is properly managed.

Growth is shown by working group and general timber type in the following table.

Table 1. Potential Mean Annual Growth for Sacramento Working Circle.

Working Group	Rotation Period	Ponderosa Pine		Mixed-conifer and Spruce-fir		Total	
		Acres	*M Bd.ft.	Acres	*M Bd.ft.	Acres	*M Bd.ft.
Technical Group	120	79,393	16,673	115,335	27,911	194,728	44,584
Christmas Tree Group	120	620	130	2,316	561	2,936	691
Administrative Group	200	2,262	486	4,379	1,156	6,641	1,642
Total		82,275	17,289	122,030	29,628	204,305	46,917
*Scribner							

Field studies were made to determine site indices. The average 100-year site index was determined to be 80 on ponderosa pine for the ponderosa pine timber type. The average 100-year site index was determined to be 100 on Douglas-fir for the mixed-conifer and spruce-fir timber types. Mean annual growth is shown below by site and by rotation age.

Species	Site Index	Technical Working Group Rotation Age 110 years Rotation Period 120 years Per Acre	Administrative Working Group Rotation Age 200 years Rotation Period 200 years Per Acre
Ponderosa Pine	80	210 bd. ft.	215 bd. ft.
Douglas-fir	100	242 bd. ft.	264 bd. ft. (est.)

The total mean annual growth and annual harvest potential is established as:
Sawtimber . . . . . 46,917,00 bd. ft. - Scribner
Christmas trees . . . . . 1,000,000 each

2. Periodic Annual Increment.

The periodic annual growth for this working circle is 22,458 M bd. ft., Scribner, for the period July 1, 1961 through June 30, 1981. This growth is based upon the present basal area stocking of all the commercial timber stands. (Details of the calculation of the periodic annual growth are in X., E.)

Growth is shown by working group and general timber type in the following table.

Table 2. Periodic Annual Growth for the Sacramento Working Circle.

Working Group	Rotation Period	Ponderosa Pine		Mixed-conifer and Spruce-fir		Total	
		Acres	M Bd.ft.**	Acres	M Bd.ft.**	Acres*	M Bd.ft.**
Technical Group	120	57,709	5,388	107,417	15,547	165,126	20,935
Christmas Tree Group	120	620	50	2316	456	2,936	506
Administrative Group	200	1,611	279	4284	738	5,895	1,017
TOTAL		59,940	5,717	114017	16,741	173,957	22,458

* 30,348 acres are nonstocked or stocked with reproduction only.

** Scribner

Normal mean annual growth per acre is expected in the Southwest if the basal area stocking per acre is maintained at levels lower than those of fully stocked stands. These levels are determined for ponderosa pine from Technical Bulletin 630, (14) and they are determined for Douglas-fir from Technical Bulletin 201. (15) The optimum stocking level is established as 57% of fully stocked basal area. The maximum stocking level is established as 80% of fully stocked basal area.

At the present, the actual stands average 44% understocked in relation to the established optimum stocking level. A portion of the periodic annual growth will be left on the stems as a means of building the basal area stocking toward the optimum level.

Past-cutting records show that there has not been sufficient market to use the full available cut each year. The cutting budget for the period July 1, 1961 through June 30, 1971, has been estimated as 93,120 M bd. ft., Scribner. This is a substantially lower figure than the 224,580 M bd. ft. growth. Cutting will be controlled by area.

Even though the entire working circle averages 44% understocked, there are stands that are overstocked now. Through precommercial thinning, through intermediate cuts, and through reproduction cuts, these stands will be thinned to the optimum 57% basal area stocking. As other stands reach the maximum 80% basal area stocking, they will also be cut to the optimum 57% stocking.

It is planned to develop the Christmas tree market as rapidly as possible so that the proposed annual cut of one million trees can be achieved.

D. Records

1. Record of Regeneration

A record system will be developed to record amount of regeneration area cut annually, and the date it becomes stocked.

2. Compartment Folder

A compartment folder should be maintained which will have pertinent information on site indexes, stand sizes, and ages, and yields from the methods of cutting.

IX. FOREST DEVELOPMENT.

A. Transportation.

The network of major roads which are necessary for the continued harvest of timber from the Sacramento Working Circle has been established for the most part. (See Transportation Map, in the Appendix, X., F.) However, many roads require relocation and/or reconstruction to permit adequate harvest of the timber resource.

Table Number 3 lists the road program which is important to the 5-year harvesting program. As the sales program is extended and amended, the transportation plan will also be modified. Details of the overall long-range road construction and reconstruction program for the Lincoln National Forest may be found in the Twelve Year Road and Trail Program Report.

Talbe 3. Transportation Plan for Timber Harvest on Sacramento

Road Number	Road Name	Year Work to Start on Road	F.S. Road Standard	Miles to be Constr.	Approx. Cost of Constr.	Constr. Cost to For.Serv.	Constr. Cost to Operator
8162	Wofford	1962	SL16	2.0	$ 5,240	$3,240	$2,000
---	Slough Canyon	1962	SL16	2.0	14,900	5,900	9,000
8A254	Board Canyon	1963	SL16	.8	1,200	---	1,200
8171	Perk Canyon	1963	SH16 & SH20	5.1	29,565	5,145	24,420
8160	Bluewater Canyon	1963	SL16	3.0	3,420	---	3,420
864	Sacramento	1964	SN16	7.0	70,000	50,000	20,000

The lack of suitable access is a problem confronting administrators in planning the sales program. Table 4 lists rights-of-way needed to permit carrying on the 5-year sales program.

Table 4. Rights-of-Way Needed for Timber Harvest

Location of Rights-of-Way	Land Owner(s)	Proposed Sale	Date Right-of-Way Needed for Road Construction
Sixteen Springs Road	Groesbeck	Slough	1961
Dry Canyon-James Canyon	Wimsatt	Dry Canyon	1961
Sacramento	Sacramento Methodist Assembly	Sacramento	1962
James Canyon	Wimsatt, Baird, Lane, Cauthen & Kirkpatrick	James Canyon	1963
Wills Canyon	Bounds & Mershon	Penasco	1964
Miller Flats	R. Miller, Joe Miller, Geo. Miller, Rex Lewis	Miller Flats	1964

B. Reforestation.

Reforestation is the biggest job that foresters on the Sacramento Working Circle will have to learn to handle during the coming cutting period. The challenge is great, but success is a must, if we are to practice forestry here.

The big reforestation job on this working circle is the restocking of the large burns that have occurred during the last decade. During the first cutting period it will be necessary to restock 21,688 acres of denuded pine stands and 7,566 acres of denuded mixed-conifer and spruce-fir stands.

Although much must be learned about successful regeneration in the Southwest, some basic knowledge is available. Efforts during the next five years will be to learn how to successfully apply this knowledge and to develop techniques that will enable us to reforest our stands satisfactorily and economically. Success is not assured at this time, so it is probable that some of the acres treated in the next five years will have to be re-treated.

1. Regeneration Studies Needed.

a. Planting and Direct Seeding Studies.

Present planting and direct seeding technique studies on the Sacramento Working Circle should be continued on a larger scale until more information has been obtained. These studies are as follows.

(1) Direct seeding in spots.

(2) Broadcast seeding.

(3) Site preparation.

(4) Mulching studies with oak leaf, burlap, freezer paper, and pine needle litter.

(5) Sandwich material.

(6) Fertilizer studies.

(7) Maintain deer exclosure studies to determine damages caused to reproduction by this species.

(8) Artificial shade.

b. Soil Studies.

Basic information about the soil is lacking for the denuded areas of the working circle. To aid administrators in selecting proper regeneration techniques, the following studies should be conducted at once.

(1) Soil condition surveys.

(a) Determine the fertility of soil from surface to planting depth.

(b) Determine which nutrients are deficient in the soil, and what corrective measures are required in fertilization.

(c) Determine the effect that site preparation has on (a) and (b) above. Suggest methods to reduce or eliminate competition without adverse effects on soil fertility and desirable structures.

(2) Soil Moisture Studies.

(a) Determine soil moisture needed for survival of seedlings.

(b) Study weather records to see if predictions can be made for the probable success of seedlings' growth.

(3) Soil Temperature Surveys.

Determine the effects that temperature has on successful regeneration within the denuded areas.

c. Site Index Surveys.

Classify areas as to productivity, and for prediction of initial success and economic returns on various sites. Also, Site Index Surveys would be a guide to species suitable for various sites. Site Index will be determined during compartment examination.

d. Rodent Damage.

Gophers and mice are very active on this working circle and are believed to be an important factor in the failure of denuded areas to restock. Where destructive agents have devastated the land, rodents are numerous. Large scale control measures, in cooperation with the U.S. Fish and Wildlife Service, are necessary to control rodents in reforestation areas. Predators that will help keep rodent populations low following artificial control should be encouraged.

e. Damage by Deer.

Burns are a favorite habitat of deer. Present plantations are experiencing damage from these animals. Hunters should be directed to these areas. It is planned to test deer repellants as to their effectiveness in preventing browsing. However, for the working circle as a whole, proper stocking of big game animals is necessary to prevent excessive damage to natural and artificially regenerated stock.

f. Browsing by Domestic Livestock.

Regeneration will be protected from browsing by domestic stock, through proper stocking, distribution, and total exclusion.

g. Damage by Insects and Disease.

Insects and diseases may be detrimental to successful artificial regeneration to a degree that has not been previously realized. Studies should be conducted to determine effects and suggest corrective measures.

2. Natural Regeneration.

The major factors affecting regeneration are: seed supply, seed bed, climate, cutting practice, and protection. We can control all these factors except climate, and we can manipulate certain factors such as vegetation, to take advantage of the favorable aspects of climate. Natural regeneration occurs abundantly on the working circle. The above factors are satisfactory frequently enough to allow establishment of some reproduction almost every year.

There should be little difficulty experienced in obtaining proper stocking following regeneration cuts.

The following discussions on regeneration of ponderosa pine and mixed-conifer stands are to outline basic information to insure that this information will not be overlooked in making the regeneration cuts, and to point out that some natural restocking can take place in denuded areas through application of certain practices.

The following information on natural regeneration applies equally well to artificial regeneration and pertinent information will not be repeated under the section on artificial regeneration.

a. Ponderosa pine.

Experience has shown that germination and survival are better when ponderosa pine seeds are buried in contact with mineral soil. Partial shade favors germination, but later effects are, on the whole, detrimental to seedlings. Survival and growth are greatly enhanced by removal of competing vegetation. (4) and (5)

(1) Regeneration Cut.

(a) Ten to fourteen seed trees per acre will be kept. These seed trees will be harvested after reproduction becomes well established.

(b) Site preparation, consisting of removal of slash and competing vegetation in strips along contours, should be employed to aid prompt establishment of seedlings.

(2) Natural Regeneration on Devastated Areas.

(a) Seed trees within devastated areas will not be cut, regardless of their condition, until reproduction is established within their zone of influence. Recent reports indicate that this zone of influence of a seed tree is not much greater than one chain, on level ground.

(b) In years of good seed production, areas adjacent to seed supply should have site preparation to remove competing vegetation and expose mineral soil prior to dissemination of seed.

(c) Rodents are very active within burned areas on the Sacramento Working Circle. This may be the prime reason for lack of natural revegetation within the areas. Controls will be necessary and should be applied prior to the good seed crops. Follow-up treatment will probably be necessary.

b. Mixed-conifer Stands.

(1) Seed Trees.

Ten to fourteen seed trees per acre will be left, if possible. These seed trees should be healthy dominant trees that are presumably the best seed producers. From Virgin stand or 2nd growth?

(2) Species.

Composition of the mixed-conifer stand on this working circle is predominately Douglas-fir (Pseudotsuga menziesii), white fir (Abies concolor), Engelmann spruce (Picea engelmanii), limber pine (Pinus flexilis) and ponderosa pine (Pinus ponderosa var. scopulorum).

Important considerations of each species are discussed below.

(a) Douglas-fir.

Douglas-fir is the most important species in this type, in terms of the wood product. Natural regeneration of Douglas-fir is greatly influenced by the character of the topsoil. A light-colored, loose, granular soil is more favorable than tight, dark soils. Litter is important for the protection of seeds and seedlings. Litter should be loose and open, rather than thick and dense. Litter from the pines or broadleaf trees is preferable to litter from Douglas-fir or white fir.

Douglas-fir seedlings require shade when very young. However, after the seedlings have become established, shade may prove to be detrimental on cool sites.

Competition from other trees, shrubs, and herbacious growth, hinders the growth of Douglas-fir. (7)

Past cutting practices within the working circle have encouraged white fir over Douglas-fir.

(b) White Fir.

White fir is probably our fastest-growing species. It reproduces well under a variety of conditions, but does best on cool sites. White fir seed germinates at a low temperature, which enables it to establish good root systems before the soil dries out. White fir is very tolerant, and thick duff does not seem to hinder its establishment. Its seed is relatively unattractive to birds and mice. (7)

All these factors explain why white fir reproduction occurs abundantly where a seed supply is available. It tends to replace Douglas-fir, particularly on the cooler sites. Previously, white fir had little or no commercial value. However, rather recent developments have at least partially changed this picture. This species may offer a solution to the reforestation of vast denuded areas. It is planned to keep the percent of white fir in a natural balance in the stands. However, it would be better to have the large burns stocked with white fir than to have them unstocked.

(c) Limber Pine.

Limber pine is also an adaptable species. It has many of the same wood uses as ponderosa pine. Limber pine reproduces on both cool and warm sites and both in shade and in the open. This appears to be because of the large size of the seed. This species does well on denuded lands, as mice do not seem to bother it, and litter is not essential. (7)

(d) Ponderosa Pine.

Ponderosa pine requires abundant heat and light. In the mixed-conifer type, it is generally found on the more open south and west exposures.

Other considerations have already been discussed.

(e) Engelmann Spruce.

Engelmann spruce occurs in the higher elevations and on north exposures of the mixed-conifer types. Spruce does not reproduce well in shade or where appreciable amounts of litter or duff are present. (7)

nor in full sunlight

(3) Recommendations to Aid Natural Regeneration.

Based on the foregoing considerations, the following recommendations are made to aid natural regeneration.

(a) Seed Trees to be Left.

Suggested proportion of seed trees to leave is as follows:

On cold slopes: 50% Douglas-fir; 30% white fir; 20% limber pines. Engelmann spruce should be left, in place of white fir, where conditions are favorable for spruce seed germination and survival.

On warm slopes: 50% Douglas-fir; 40% ponderosa pine; and 10% white fir. Where available, limber pine should be left to aid restocking of denuded areas.

(b) Slash Disposal.

Lopping and scattering slash, following the reproduction cut, should provide needed shade for Douglas-fir.

(c) Competitive Vegetation.

Where reproduction has become established under broadleaf trees, increased survival and growth may be obtained by killing the competition through spraying, girdling, or poisoning. The cutting of seed trees soon after seedlings are well established will also reduce competition and increase light.

3. Artificial Regeneration.

The Allen Canyon fire (1951), Circle Cross fire (1953), and Pendleton fire (1956) plus cutting-rights harvests, have denuded large areas of commercial timberland. These areas must be restocked within the next 20 years. This restocking job is summarized below:

	Burned Area Acres	Annual Regeneration Job Acres
Ponderosa pine stands	21,668	1,083
Mixed-conifer stands	7,566	378

The next two years' efforts will be directed toward continuing to learn how to successfully seed, how to transplant native stock, and how to plant nursery stock. The following table shows the amount of plantings ordered from Region 2, for 1962 - 1964. No appreciable increase in nursery stock will be available until 1964.

Table 5. Plantings Ordered from Region 2

	Ponderosa pine	Douglas-fir	White fir	Engelmann spruce	Limber pine	Total
1962	11 M	4 M			6 M	21 M
1963	10 M	10 M		5 M	5 M	30 M
1964	750 M					750 M

Failure to receive planting stock at the proper time, and receipt of ungraded stock containing specimens of poor quality have undoubtedly been a factor in recent plantation failures on the Sacramento Working Circle. The establishment of the Basalt Nursery in Colorado should permit receiving stock at the proper time. Only top quality stock should be shipped from the nursery. Grading can be done better at the nursery than at the planting site. Special transportation arrangements are also needed to insure quick delivery of the stock.

If all the devastated areas are stocked artificially from nursery 2 - 1 stock, the following approximate amounts will be needed annually:

Species	Amount 2 - 1 Stock
Ponderosa pine	1,000 M
Douglas-fir	170 M
White fir	284 M
Engelmann spruce	57 M
Limber pine	28 M
Total	1,539 M

These amounts should be ordered for 1965 and 1966. These amounts may be reduced in future years if success can be obtained through direct seeding or by transplanting naturals. However, with so large an undertaking ahead of us, it does not seem possible at this time to incur a surplus. If successful planting can be demonstrated on the Lincoln National Forest, a local nursery is a must for the near future. In addition to the areas under discussion, there are large acreages of commercial timberland that are supporting only oak brush, as a result of fires of 20 or more years ago. These lands are restocking only slowly. The Lincoln Division of this forest has also experienced large fires that have devastated vast acreages.

a. Degree of Stocking.

Experience on this working circle and other areas indicates that through proper planting techniques, including site preparation and control of rodents and other animals, that we may hope for survival of about 40%. Three hundred-fifty stems per acre is the estimated average number of stems to be grown to 8" d.b.h. on moderate sites. It is expected that, in the future, markets will be available for this size material. Three hundred-fifty stems is increased by the expected mortality of 60% which gives a stocking figure of 875 stems per acre.

It is estimated that 90% of the losses will occur in the first 10 years, leaving about 400 trees per acre.

At 2" d.b.h., four hundred trees occupy about 12% of the site. Fuller use of the site may be obtained on mixed-conifer types by growing Christmas trees between rows of future crop trees. Planting of 1,500 trees per acre will allow full development of growing stock and development of well-formed Christmas trees. Two hundred-fifty to five hundred Christmas trees per acre could be harvested from these plantings at 10 years of age. If this practice proves successful, it may be desirable and feasible to plant Christmas trees between rows on the better pine sites.

It is proposed to plant 875 stems (Christmas trees) per acre on ponderosa pine sites, and 1,500 stems per acre on mixed-conifer. Species composition on mixed-conifer sites will be as follows at time of planting: 30% Douglas-fir; 50% white fir; 5% limber pine; 10% Engelmann spruce; and 5% ponderosa pine.

Christmas tree cuts will strive to leave 40% Douglas-fir; 30% white fir; 10% ponderosa pine; 10% Engelmann spruce, and 10% limber pine.

Although this is considered a reasonable standard, it should not be confused with minimum acceptable stocking as a guide to fill in planting. Because of cost and final returns, one hundred trees per acre will be considered acceptable. Where Christmas trees above this 100 per acre are present, no planting or replanting will be made.

b. Site Preparation.

Site preparation will be needed to reduce and eliminate competing vegetation prior to planting. This is believed to be essential for satisfactory seedling survival and growth of ponderosa pine and Douglas-fir. Site preparation will be necessary before direct seeding ponderosa pine to enable the seed to make contact with mineral soil.

c. Direct Seeding.

Because of the characteristics of the species involved, direct seeding in mixed-conifer stands may hold more promise than direct seeding in ponderosa pine stands.

On cool slopes, both broadcast seeding and seeding in spots should be tried under aspen canopy. Use a mixture of Douglas-fir, white fir and limber pine. On south exposures, under a canopy of oak, it is felt a mixture of Douglas-fir and limber pine holds some promise. In very thick oak stands, it may prove necessary to kill a portion of the stand through herbicide spray. Possibly in these stands, the dead limbs will provide sufficient shade for Douglas-fir seedlings and would permit totally killing the oak stand. Various degrees of kill should be tried. After seedlings are well established, they should be released by killing the broadleaf overstory. Past efforts in direct seeding ponderosa pine have proven most successful when the seed were planted in hills about 1/2" deep, with eight to ten seeds per hill.

In other pine areas, the failure of sufficient seed to come into contact with mineral soil and subsequently be covered with soil, has caused broadcast seeding to be a failure. However, on the Lincoln National Forest, pine regeneration has flourished and has been established on seed beds that appear to be undesirable for this species. For this reason, on the Sacramento Working Circle, both methods merit further trial. It is suggested that where competition from herb vegetation is heavy, that prescribed burning be tried prior to broadcast seeding.

The amount of seed to use is a matter of speculation. It is known that in nature, regeneration usually occurs by saturation of an area with seed. It is economically impossible to duplicate nature. However, through reduction of seed predators, site preparation, and proper seed placement, we should be able to get by with a greatly reduced amount of seed.

d. Seed Program.

The artificial reforestation program for this working circle will require a volume of seed from local sources. The seed should be obtained from trees of good vigor and from within the elevation range of regeneration sites.

The following Table, Number 6, "Cones To Be Collected," indicates the minimum amount of cones needed for direct seeding requirements and for the nursery to make adequate plantings to meet the proposed order of 1965.

Table 6. Cones to be Collected

Species	Avg. No. Lbs. seed per Bu. of Cones	No. of Seeds per Pound	Germination percent	Stock Required 1965	No. of Bu. of Cones for Seedlings	Bu. cones Needed Annually for Direct Seeding	Total Bushels Needed Annually
Pinus Ponderosa	1	12,000	60	1 MM	139	4,000	4,139
Abies concolor	3	15,100	34	284 M	18	259	277
Pseudotsuga menziesii	1	42,000	72	170 M	6	468	474
Pinus flexilis	(Estimated - No figures available)				5	450	455
Picea engelmannii	5	135,000	67	57 M	1	312	313

To carry on direct seeding work requires a tremendous volume of cones as evidenced above.

Good cone crops occur only about every three to five years on this working circle. The lack of seed may delay undertaking this direct seeding on a very large scale.

During "crop" years, every effort must be made to stock-pile seed to make up for poor years and to meet emergencies.

Special facilities will be required for handling, drying, and seed separation on this large a scale. Possibly this work could be contracted locally to a firm with such facilities.

Tests should be made to determine the need and advisability of treating and pelletizing seed.

Table 7. Possible Treatment Under Artificial Regeneration Program - Fiscal Year 1962 and 1963

	Ponderosa Pine		Mixed-conifer	
	M Trees	Acres	M Trees	Acres
Acres to restock		1,083		378
Plant domestic stock	146	167	150	100
Nursery stock	11	13	10	7 - 5
Direct Seeding -				
Broadcast		450		100
Hills		450		170
Rodent Control		3,000		1,500
Site Preparation				
Mechanical		180		
Herbicides				50
Fire		100		
Miles of Fence to be Built		Variable		Variable
Repellant Experiment	1			.5
Experiment with Shade Devices	1			1

Current studies will be continued. Basic studies of soil and site should be initiated.

C. Cultural Practices Under the Knutson-Vandenberg Act.

Cultural practices will be planned for individual sale areas rather than for the working circle as a whole, due to the variety of vegetative types and stand conditions.

Thinning will be the major Timber Stand Improvement practice on the working circle. Efforts will be made to find a market for the resulting small products, and so ease the load of putting the stands into optimum growing condition. Regional guidelines as established by the Timber Management division in the Regional Office will govern thinning practices.

Pruning will be a minor program over the working circle because of the high incident of dwarfmistletoe in both pine and mixed-conifer stands. Region 3 guidelines as established, will govern practices under this program.

D. Sales Policy.

1. Cutting Budget.

a. Scheduled Sales Through F.Y. 1963.

The following schedule of sales through F.Y. 1963 has been established.

Map No.	Name of Sale	Size MM Bd. Ft.-Scribner	Estimated Annual Cut MM Bd. Ft. - Scribner F.Y. 1962	F.Y. 1963
1.	Pinon Draw	Sold	4.50	---
2.	Bluewater	14.00	---	4.50
3.	McEwan	.50	.50	---
4.	Sacramento	1.00	---	.50
5.	Curtis Canyon	.85	.85	---
6.	James Ridge	.11	.11	---
7.	Bear Canyon	.65	---	.40
8.	Dry Canyon	.30	.30	---
9.	Slough	1.00	.25	.50
10.	Upper Burnt	.15	.15	---
11.	Bell	.25	.25	---
12.	James Canyon	2.00	---	---
13.	Wofford	2.00	1.00	1.00
14.	Nelson	1.25	---	---
	Total		7.91	6.90

This will leave a deficit of 1.4 million board feet in F.Y. 1962 and 2.4 million board feet in F.Y. 1963. This 3.8 million board foot deficit should be made up during the next 10 years.

b. Scheduled Sales, F.Y. 1964 through F.Y. 1966.

The cutting budget for the F.Y. 1964, 1965 and 1966 will be as outlined below.

		Estimated Annual Cut MM Bd. ft.-Scribner		
Map No.	Name of Sale	F.Y. 1964	F.Y. 1965	F.Y. 1966
2.	Bluewater	4.50	4.50	.50
4.	Sacramento	.50	---	---
7.	Bear Canyon	.25	---	---
9.	Slough	.25	---	---
12.	James Canyon	1.00	1.00	---
14.	Nelson	.50	.50	.25
15.	Hornbuckle	2.30	.80	---
16.	Pepper	---	.50	4.00
17.	Scott Able	---	2.50	4.50
	Total	9.30	9.30	9.25

The sale units are shown on the Cutting Plan Map in the Appendix.

A budget of entry based on regulation by area control will be prepared to replace the cutting budget after the working circle is divided into compartments.

2. Other Sale Considerations.

Logging plans which incorporate logging practice recommendations and restrictions set forth in District Multiple Use Plans shall be prepared by each district for sales within ranger authorizations. A copy of this plan shall be made a part of all ranger sales in which there is any possibility of damage to other resources.

On supervisor size sales, or larger, logging plans incorporating the above recommendations and restrictions shall be prepared for each individual sale.

Since most present mills have small capacities, and since the relative portability of these small mills will aid in harvest of scattered tracts of timber, a portion of the allowable cut shall consist of small sales within the operating range of the small mill owners. This portion may vary with the needs of the stand.

E. Prescription of Silviculture Treatment.

The prescription should contain the following.

1. A map of the area under consideration.

a. Stands containing 10 acres or more should be delineated by age-classes of 0 - 20 years; 20 - 40 years; 40 - 60 years; 60 - 80 years; 80 - 100 years; and 100 - 120 years. Diameter classes or average stand diameter may be used to segregate age-classes.

b. Stands should also be delineated by site index.

c. Stands should be numbered, with similar stands having the same number.

d. Regeneration areas should be delineated.

e. Areas for other use considerations or special treatment (Recreation zones, etc.) should be outlined.

2. Written Prescription.

a. History of silvicultural treatment.

b. Site index with basal area objectives.

c. Silvicultural treatment by stand number.

d. Total acres of different treatments.

(1) Regeneration.
(2) Thinning.
(3) Operable cuts.

e. Estimated costs.

f. Estimated cut with sale data.

X. APPENDIX

A. Bibliography

(1) Andrews, Stuart R., and Daniels, John P. A Survey of Dwarf-mistletoes in Arizona and New Mexico. Fort Collins, Colorado, Rocky Mountain Forest and Range Experiment Station, 1960. (U.S. Department of Agriculture, Forest Service, Station Paper No. 49).

(2) Curtis, James D., and Lynch, Donald W. Silvics of Ponderosa Pine. Ogden, Utah, Intermountain Forest and Range Experiment Station, 1957. (U.S. Department of Agriculture, Forest Service, Miscellaneous Publication No. 12).

(3) Gill, Lake S. Dwarfmistletoe of Ponderosa Pine in the Southwest. Fort Collins, Colorado, Rocky Mountain Forest and Range Experiment Station, 1954. (U.S. Department of Agriculture, Forest Service, Station Paper No. 14.).

(4) Gross, L.S., Forester, Division of Timber Management, Forest Service, Washington Office. Timber Management Plans on the National Forests. Washington, D. C., U.S. Department of Agriculture, Forest Service, 1950.

(5) Hallin, William E., California Forest and Range Experiment Station, U.S. Department of Agriculture, Forest Service. The Application of Unit Area Control in the Management of Ponderosa-Jeffrey Pine at Blacks Mountain Experimental Forest. Washington, D.C., U.S. Department of Agriculture, Forest Service, May, 1959. (U.S. Department of Agriculture Technical Bulletin Number 1191).

(6) Hawksworth, Frank G., Forest Pathologist, Rocky Mountain Forest and Range Experiment Station, and Lusher, Arthur A., Forester, Western Washington Indian Agency, Everett, Washington. Dwarfmistletoe Survey and Control on the Mescalero-Apache Reservation, New Mexico. Washington 6, D.C., Society of American Foresters, 1956. (Journal of Forestry, vol. 54; No. 6, Part 1, p. 384 - 390.)

(7) Krauch, Hermann. Management of Douglas-Fir Timberland in the Southwest. Fort Collins, Colorado, Rocky Mountain Forest and Range Experiment Station, 1956. (U.S. Department of Agriculture, Forest Service, Station Paper No. 21).

(8) Pearson, G.A., Silviculturist, Southwest Forest and Experiment Station, U.S. Department of Agriculture, Forest Service. Management of Ponderosa Pine in the Southwest. Washington, D.C., Government Printing Office, 1950 - 892292. (U.S. Department of Agriculture, Forest Service, Agriculture Monograph No. 6).

(9) U.S. Department of Agriculture, Forest Service Region 3, Region 3 Timber Management Handbook. Albuquerque, New Mexico, Forest Service, Region 3, 1950.

(10) Frary, Ladd G. Statewide Big Game Random Card Survey. Santa Fe, New Mexico, New Mexico State Department of Game and Fish, 1961. (Federal Aid Project W-93-R-2 Job Completion Report).

(11) Harrington, Fred A. Deer Distribution and Population Studies. Santa Fe, New Mexico, New Mexico State Department of Game and Fish, 1960. (Federal Aid Project W-75-R-7 Job Completion Report).

(12) Meyer, Walter H., Formerly Silviculturist, Pacific Northwest Forest Experiment Station, Forest Service, Portland, Oregon. Yield of Even-Aged Stands of Ponderosa Pine. Washington, D.C., U.S. Department of Agriculture, Forest Service, 1938, Slightly Revised 1961. (U.S.D.A. Technical Bulletin No. 630).

(13) McArdle, Richard E., Silviculturist, Pacific NW Forest and Range Experiment Station, Forest Service, Portland, Oregon; Meyer, Walter H., Silviculturist, and Bruce, Donald, Collaborator. The Yield of Douglas Fir in the Pacific Northwest. Washington, D.C., U.S. Department of Agriculture, Forest Service, 1949, Slightly Revised 1961. (U.S.D.A. Technical Bulletin No. 201).

(14) U.S. Department of Agriculture, Forest Service, Forest Service Manual. Washington, D.C., U.S. Department of Agriculture, Forest Service, 1957 - 1958, and amendments. (Title 2400).

(15) U.S. Department of Agriculture, Forest Service, Forest Service Handbook. Washington, D.C., U.S. Department of Agriculture, Forest Service, 1957 - 1958, and amendments. (Title 2400).

(16) U.S. Department of Agriculture, Forest Service Handbook. Washington, D.C., Department of Agriculture, Forest Service, 1957 - 1958, and amendments. (Title 5100).

(17) U.S. Department of Agriculture, Forest Service, Forest Service Roads Handbook. Washington, D.C., Department of Agriculture, Forest Service. 1957 - 1958, and amendments. (Title FSH 5610.42, Category 2 Handbook).

(18) U.S. Department of Agriculture, Forest Service Region 3, Lincoln National Forest Recreation Survey. Albuquerque, New Mexico, Forest Service Region 3. 1959.

(19) U.S. Department of Agriculture, Forest Service Region 3, Cloudcroft District Multiple Use Plan. Alamogordo, New Mexico, Forest Supervisor's Office, Lincoln National Forest. 1960.

(20) U.S. Department of Agriculture, Forest Service Region 3, Mayhill District Multiple Use Plan. Alamogordo, New Mexico, Forest Supervisor's Office, Lincoln National Forest. 1960.

(21) U.S. Department of Agriculture, Forest Service Region 3, Weed District Multiple Use Plan. Alamogordo, New Mexico, Forest Supervisor's Office, Lincoln National Forest. 1960.

B. Timber Data

Table 8. Commercial Acreage by Working Group, General Condition Class, and Timber Type

Working Group	General Condition Class	Timber Types - Acres			Total Acres
		Ponderosa Pine	Mixed-conifer	Spruce-fir	
Technical Working Group	Virgin	1,224	2,607	---	3,831
	Cutover	42,777	85,420	1,630	129,827
	*Young Growth & Regeneration	35,392	25,660	18	61,070
Total - - - - - - - - - - - - - -		79,393	113,687	1,648	194,728
Administrative Working Group	Virgin	---	1,047	---	1,047
	Cutover	958	2,650	29	3,637
	*Young Growth & Regeneration	1,304	653	---	1,957
Total - - - - - - - - - - - - - -		2,262	4,350	29	6,641
Christmas Tree Working Group	Virgin	620	2,316	---	2,936
GRAND TOTAL - - - - - - - - - - -		82,275	120,353	1,677	204,305

*Includes non-stocked areas.

Table 9. Commercial Net Volumes by Working Group - Mbf. Scribner

Working Group	Timber Type	General Condition Class - Mbf. Scribner: Commercial Operable	Young Growth & Regenerating	Inaccessible	Total
Technical Working Group	Ponderosa pine	75,547.4	8,640.2	6,300.4	90,488.0
	Mixed-conifer	375,369.8	30,291.8	25,065.0	430,726.6
	Spruce-fir	18,747.7	---	---	18,747.7
Total - - - - - - - - - -		469,664.9	38,932.0	31,365.4	539,962.3
Administrative Working Group	Ponderosa pine	1,680.0	441.2	---	2,121.2
	Mixed-conifer	20,765.9	818.9	---	21,584.8
	Spruce-fir	343.1	---	---	343.1
Total - - - - - - - - - -		22,789.0	1,260.1	---	24,049.1
Christmas Tree Working Group	Ponderosa pine	919.4	---	---	919.4
	Mixed-conifer	9,730.6	---	---	9,730.6
Total - - - - - - - - - -		10,650.0	---	---	10,650.0
Working Circle Totals	Ponderosa pine	78,146.8	9,081.4	6,300.4	93,528.6
	Mixed-conifer	405,866.3	31,110.7	25,065.0	462,042.0
	Spruce-fir	19,090.8	---	---	19,090.8
GRAND TOTAL - - - - - -		503,103.9	40,192.1	31,365.4	574,661.4

Table 10. Net Volumes by Species - Mbf. Scribner

(Commercial Forest Land - National Forest Only)

Working Group	Stand Condition	Ponderosa Pine			Douglas-fir	White fir	Engelmann Spruce	Limber Pine	TOTAL
		Black Jack	Yellow Pine	Subtotal					
Technical Working Group	Virgin	879.9	4,165.3	5,045.2	10,172.4	5,283.4	64.9	2,335.8	22,901.7
	Cutover	13,201.3	123,772.4	136,973.7	191,221.3	98,714.1	14,254.8	44,531.3	485,695.2
Total - - - - -		14,081.2	127,937.7	142,018.9	201,393.7	103,997.5	14,319.7	46,867.1	508,596.9
Administrative Working Group	Virgin	257.7	750.1	1,007.8	4,544.7	1,947.2	35.3	855.6	8,390.6
	Cutover	314.1	3,476.5	3,790.6	6,584.4	3,414.6	366.6	1,502.3	15,658.5
Total - - -		571.8	4,226.6	4,798.4	11,129.1	5,361.8	401.9	2,357.9	24,049.1
Christmas Tree Working Group	Virgin	1,322.4	2,283.0	3,605.4	4,169.3	1,055.8	---	1,819.5	10,650.0
Working Circle	Virgin	2,460.0	7,198.4	9,658.4	18,886.4	8,286.4	100.2	5,010.9	41,942.3
	Cutover	13,515.4	127,248.9	140,764.3	197,805.7	102,128.7	14,621.4	46,033.6	501,353.7
TOTALS - - - - -		15,975.4	134,447.3	150,422.7	216,692.1	110,415.1	14,721.6	51,044.4	543,296.0

Table 11. Gross Volumes per Acre by Types, Species, and Condition Class.

Virgin Timber. Bd. ft. Scribner

*Timber Type	Species						Total
	Ponderosa Pine	Black Jack	Douglas-fir	White fir	Limber pine	Engelmann spruce	
P8PV (1)	27.7	9.9	---	---	---	---	37.6
P8MV (2)	1,178.2	41.8	7.3	---	---	---	1,227.3
P9PV	1,807.2	18.2	65.5	---	76.4	---	1,967.3
P9MV (3)	1,807.2	18.2	65.6	---	76.4	---	1,967.3
MC8PV (4)	960.0	---	234.3	---	---	---	1,194.3
MC8MV (5)	520.0	---	974.5	272.7	356.4	---	2,123.6
MC8WV (6)	192.7	---	1,036.4	2,843.6	178.2	---	4,250.9
MC9PV	1,598.9	653.3	1,926.9	421.1	1,013.3	---	5,613.5
MC9MV	1,076.6	561.8	3,296.8	1,238.5	1,473.2	---	7,647.9
MC9WV	499.7	24.6	7,555.7	3,408.6	1,104.3	63.7	12,656.6
Aspen			80.0	2,620.0			2,700.0

*See Timber Type Legend, following Table 12.

(1) Insufficient plot data, volumes based on P8PC

(2) Insufficient plot data, volumes based on P8MC

(3) Insufficient plot data, volumes based on P9PV

(4) Insufficient plot data, volumes based on MC8PC

(5) Insufficient plot data, volumes based on MC8MC

(6) Insufficient plot data, volumes based on MC8WC

Table 12. Gross Volumes per Acre by Types, Species, and Condition Class.

Cutover Timber. Bd. ft. - Scribner

Timber Type	Species						Total
	Ponderosa Pine	Black Jack	Douglas-fir	White fir	Limber Pine	Engelmann Spruce	
P7MC							0
P8PC	27.7	9.9					37.6
P8MC	1,178.2	41.8	7.3				1,227.3
P8WC (7)	1,178.2	41.8	7.3				1,227.3
P9PC	1,728.4	208.5	73.8		23.1		2,033.8
P9MC	3,400.0		480.0				3,880.0
MC7PC							0
MC8MC							0
MC7WC							0
MC8PC	960.0		234.3				1,194.3
MC8MC	520.0		974.5	272.7	356.4		2,123.6
MC8WC	192.7		1,036.4	2,843.6	178.2		4,250.5
MC9PC	729.9	47.6	2,047.5	832.7	569.7	13.1	4,240.5
MC9MC	605.3	17.6	3,078.8	1,743.5	697.1	95.9	6,238.2
MC9WC		824.0	1,624.0	4,696.0	696.0		7,840.0
SF9PC			3,880.0	1,720.0		7,500.0	13,100.0
SF9MC (8)			3,880.0	1,720.0		7,500.0	13,100.0
A7							0
A8	36.0		920.0	120.0			1,076.0

(7) Insufficient plot data, volumes based on P8MC

(8) Insufficient plot data, volumes based on SF9PC

Timber Type Legend for Table 11 and Table 12

Symbol Used	Meaning of Symbol
P	Ponderosa pine
MC	Mixed-conifer
SF	Spruce-fir
NO	Nontimbered
NC	Brush
NPJ	Woodland
A	Aspen

Size Class	
6	Nonstocked
7	Reproduction
8	Poles
9	Sawtimber

Stocking (Crown Density)	
P	Poorly stocked (10 - 39% crown density)
M	Moderately stocked (40 - 69% crown density)
W	Well stocked (70 - 100% crown density)

Condition	
V	Virgin
C	Cutover
X	Inaccessible
R	Reserved

Thus: Symbol P9PV means ponderosa pine sawtimber, poorly stocked, virgin.
Symbol MC6 means nonstocked mixed-conifer site.
Symbol MC8WC means well stocked, cutover, mixed-conifer pole stand.
Symbol A8MX means an inaccessible, moderately stocked aspen pole stand.

Table 13. Defect factors Used to Reduce Inventory Volumes to Net

Virgin Timber

Species of Timber	Sites		
	Poor	Medium	Good
PP	25%	20%	15%
BJ	15%	10%	5%
DF	30%	25%	20%
WF	45%	35%	25%
ES	15%	10%	5%
LP	40%	30%	25%

Cutover Timber

PP	20%	15%	10%
BJ	10%	5%	0
DF	20%	15%	10%
WF	25%	20%	15%
ES	15%	10%	5%
LP	25%	20%	15%

C. Inventory

The statistical accuracy of the inventory is computed at ± 6.97 percent of error as compared with an objective of ± 5 percent. The analysis was based on 381 one-quarter acre plots with a coefficient of variation of 136. It is reasonable to expect that this coefficient will be reduced as plots are re-established following logging of existing virgin stands. An estimated 214 additional plots are needed to bring the statistical accuracy to the desired ± 5 percent. The majority of these plots are needed in poorly stocked cutover pine stands, poorly and moderately stocked cutover mixed-conifer stands, and in aspen stands.

As indicated above, the coefficient of variation is expected to decrease as plots are re-established. The majority of the re-established plots will fall into the types where additional plots are needed. If these changes were not anticipated, 359 additional plots would be needed rather than the 214.

D. Calculation of Periodic Available Cut

The available cut was calculated by an analysis of stand tables for each timber and each stocking class. The diameter sizes were given age classes, and segregated so that each age-class was represented by an equivalent amount of basal area. Excess basal area in the sawtimber size classes were cut. The basal area was converted to board feet by using a basal area/volume converting factor. Generally, cut trees were in the 20" and over d.b.h. class. This follows all experiment station study results, which have found greatest mortality of virgin timber in the upper size classes.

Since the plan is based on area regulation, the stands as found will be placed in the best silvicultural condition possible. The cut will then come about normally, as the area entered will be varied to sustain an approximately average yield of sawtimber volume. At the end of a five-year period, experience data can be used for adjustment and application to a future cutting budget.

The volume here is calculated to provide a basis for planning the expected yield.

The actual data used in the calculations are found in the files of the Forest Supervisor's office, on the Lincoln National Forest.

E. Growth Calculations

1. Growth Calculations - Region 3 Formula

The following growth calculation for poorly stocked cutover ponderosa pine stands is intended only as a check on estimated growth rates. The formulae were developed by the Southwestern Forest and Range Experiment Station and published in their report for 1952.

a. Gross Increment of Original Trees

Log gross growth = 1.9385 - .5815 (logarithm reserve volume) + 1.4366 (Log reserve basal area)

= 1.9385 - .5815 (log 2033.8) + 1.4366 (Log 21.20)

= 1.9385 - .5815 (3.3083) + 14366 (1.3263)

= 1.9385 - 1.9238 + 1.9054

= 1.9201

gross growth = 83.2 bd. ft. per acre per year.

b. Ingrowth

Log Ingrowth = 0.8601 - .2342 (log reserve # trees over 11.6 d.b.h.)

+ .6858 (log reserve # trees 7.6" - 11.5" d.b.h.)

= 0.8601 - .2342 (log 15.53) + .6858 (log 28.75)
= 0.8601 - .2342 (1.1912) = .6858 (1.4586)
= 0.8601 -0.2790 + 1.0003
= 1.5814

Ingrowth = 38.4 bd. ft. per acre per year

c. Mortality

Mortality = 1/3 [3.4142 + 0.0151 (reserve volume) - 1.2156 (reserve basal area)]
= 1/3 [3.4142 + 0.0151 (2033.8) - 1.2156 (21.2)]
= 1/3 [3.4142 + 3.0710 - 2.5771]
= 1/3 [3.908]
= 1.3 bd. ft. per acre per year

d. Net growth = Gross growth + ingrowth - mortality

= 83.2 + 38.4 - 1.3
= 120.3 bd. ft. per acre per year

2. Growth Calculations by Using Site Indices

a. Site Indices

Site index information is limited for this working circle. No site data was taken during the inventory.

Some site data was collected in 1961 by Forest personnel and by Regional soils technicians. Based on this site data, the following site indices were selected as average for the working circle.

(1) Ponderosa pine 100-year site index of 80 to be used for the ponderosa pine timber type.

(2) Douglas-fir 100-year site index of 100 to be used for the mixed-conifer, spruce-fir, and aspen timber types.

Since the source data is limited and weak, the predictions of growth and yield will also be weak. However, growth predictions in this plan are used only as an indicator of potential, as timber removal will be controlled by area.

When sufficient site data has been collected, growth and yield predictions will be revised as needed by amendment to this plan.

b. Calculation of Potential Mean Annual Growth

(1) The per acre mean annual growth data was taken from U.S.D.A. Technical Bulletin 630 for ponderosa pine, and from U.S.D.A. Technical Bulletin 201 for Douglas-fir.

Predictions for the working circle were computed as follows.

Table 14. Predictions for the Sacramento Working Circle

Timber Type	Rotation Age (Years)	Rotation Period (Years)	Mean Annual Growth per Acre - Bd. ft.-Scribner	No. of Acres	Working Circle Mean Annual Growth - Bd. ft.-Scribner
Ponderosa pine	110	120	210	80,013	16,802,730
Ponderosa pine	200	200	215	2,262	486,330
Mixed-conifer, Aspen, and Spruce-fir	110	120	242	117,651	28,471,542
Mixed-conifer, Aspen and Spruce-fir	200	200	264	4,379	1,156,056
Total				204,305	46,916,658

This prediction could be raised or lowered depending upon the future determination of acreage by each site index present in the working circle.

(2) On the Christmas Tree Working Group area, seedlings will be grown to approximately six feet high, and then will be harvested. On the Technical Working Group area, Christmas trees will be harvested as thinnings on one-twentieth of the area annually. Annual harvest is summarized below.

Table 15. Summary of Annual Harvest of Christmas Trees

	Technical Working Group	Christmas Tree Working Group
Mixed-conifer Type	105,705 Acres	2,316 Acres
Spruce-fir Type	1,648 Acres	---
Aspen Type	7,982 Acres	---
Total Acres	115,335 Acres	2,316 Acres
Divided by	120 year rotation	10 year harvest period
Annual Acreage	961 Acres	231 Acres
Harvest by Acre	600 Trees	1,900 Trees
Annual Harvest	576,600 Trees	438,900 Trees
	438,900	
Total Annual Harvest	1,015,500 rounded to 1,000,000 Trees	

c. Calculation of Periodic Annual Growth for Period July 1, 1961 to June 30, 1981

Fifty-seven percent of basal area full stocking is the optimum stocking level for the timber stands on this working circle. Through growth, basal area may be increased to 80% of full stocking. At this level, the stands will be thinned or there will be a pre-commercial cut to reduce the basal area to the optimum 57%.

Basal area stand tables were prepared for each overstory timber type and density class which was mapped on the working circle. Table 16 summarizes actual stand basal areas by diameter class.

The average number of trees per care by overstory timber type and density class are summarized in Table 17 by diameter class.

Table 16. Stand Basal Areas per Acre by Diameter Class - Sacramento Working Circle - Lincoln National Forest

Map Symbol	Timber Type	Stocking Class in % of Crown Cover	Average Basal Area per Acre in Sq. Ft. by Diameter Class				
			4"-7"	8"-11"	12"-20"	21" & Up	Total
	Ponderosa Pine						
P8PC	Cutover Poles	Poor	12.23	9.01	4.96	.78	26.98
P8MC	" "	Medium	26.14	16.69	10.90	1.59	55.32
P8WC	" "	Well	61.82	13.58	7.07	---	82.47
P9PC	Cutover Sawtimber	Poor	15.87	12.83	16.94	4.26	49.90
P9MC	" "	Medium	5.99	49.63	58.68	---	114.30
P8PV	Virgin Poles	Poor	12.23	9.01	4.96	.78	26.98
P8MV	" "	Medium	26.14	16.69	10.90	1.59	55.32
P9PV	Virgin Sawtimber	Poor	14.95	5.48	17.55	5.04	43.02
P9MV	" "	Medium	14.95	5.48	17.55	5.04	43.02
	Mixed-conifer						
MC8PC	Cutover Poles	Poor	33.27	13.59	8.33	3.58	58.77
MC8MC	" "	Medium	24.02	17.31	13.56	10.21	65.10
MC8WC	" "	Well	25.13	25.79	28.32	16.49	95.73
MC9PC	Cutover Sawtimber	Poor	14.83	13.73	23.40	17.51	69.47
MC9MC	" "	Medium	14.84	16.73	29.36	27.66	88.59
MC9WC	" "	Well	18.43	24.17	52.16	22.63	117.39
MC8PV	Virgin Poles	Poor	33.27	13.59	8.33	3.58	58.77
MC8MV	" "	Medium	24.02	17.31	13.56	10.21	65.10
MC8WV	" "	Well	25.13	25.79	28.32	16.49	95.73
MC9PV	Virgin Sawtimber	Poor	11.32	7.91	23.67	46.60	89.50
MC9MV	" "	Medium	7.20	6.09	21.47	44.17	78.93
MC9WV	" "	Well	18.43	24.17	52.16	22.63	117.39
	Spruce-fir						
SF9PC	Cutover Sawtimber	Poor	2.63	9.51	66.65	24.41	103.20
SF9MC	" "	Medium	2.63	9.51	66.65	24.41	103.20
	Aspen						
A8PC	Cutover Poles	Poor	12.30	35.78	18.26	12.57	78.91
A8MC	" "	Medium	12.30	35.78	18.26	12.57	78.91
A8WC	" "	Well	6.74	7.74	.76	---	15.24
A8PV	Virgin Poles	Poor	15.41	9.46	7.82	14.14	46.83
A8MV	" "	Medium	15.41	9.46	7.82	14.14	46.83
A8WV	" "	Well	15.41	9.46	7.82	14.14	46.83

Table 17. Stand Number of Trees per Acre by Diameter Class - Sacramento Working Circle - Lincoln National Forest

Map Symbol	Timber Type	Stocking Class in % of Crown Cover	Average Number of Trees per Acre by Diameter Class				
			4"-7"	8"-11"	12"-20"	21" & Up	Total
	Ponderosa Pine						
P8PC	Cutover Poles	Poor	87.34	18.01	5.35	.27	110.97
P8MC	" "	Medium	177.70	37.00	9.30	.80	224.80
P8WC	" "	Well	460.00	30.00	4.00	---	494.00
P9PC	Cutover Sawtimber	Poor	108.04	28.75	14.44	1.09	152.32
P9MC	" "	Medium	30.00	90.00	60.00	---	180.00
P8PV	Virgin Poles	Poor	87.34	18.01	5.35	.27	110.97
P8MV	" "	Medium	177.70	37.00	9.30	.80	224.80
P9PV	Virgin Sawtimber	Poor	120.90	10.92	14.89	1.80	148.51
P9MV	" "	Medium	120.90	10.92	14.89	1.80	148.51
	Mixed-conifer						
MC8PC	Cutover Poles	Poor	225.71	32.85	6.85	1.14	266.55
MC8MC	" "	Medium	174.56	38.21	11.95	2.53	227.25
MC8WC	" "	Well	162.73	57.28	25.05	3.60	248.66
MC9PC	Cutover Sawtimber	Poor	97.84	29.10	19.00	4.55	150.49
MC9MC	" "	Medium	96.31	35.74	23.97	7.47	163.49
MC9WV	" "	Well	122.00	50.00	44.00	6.40	222.40
MC8PV	Virgin Poles	Poor	225.71	32.85	6.85	1.14	266.55
MC8MV	" "	Medium	174.56	38.21	11.95	2.53	227.25
MC8WV	" "	Well	162.73	57.28	25.05	3.60	248.66
MC9PV	Virgin Sawtimber	Poor	80.00	20.00	16.00	12.00	128.00
MC9MV	" "	Medium	52.50	12.50	13.00	12.00	90.00
MC9WV	" "	Well	122.00	50.00	44.00	6.40	222.40
	Spruce-fir						
SF9PC	Cutover Sawtimber	Poor	20.00	20.00	44.00	8.00	92.00
SF9MC	" "	Medium	20.00	20.00	44.00	8.00	92.00
	Aspen						
A8PC	Cutover Poles	Poor	80.00	80.00	16.00	4.00	180.00
A8MC	" "	Medium	80.00	80.00	16.00	4.00	180.00
A8WC	" "	Well	36.66	17.77	.88	---	55.31
A8PV	Virgin Poles	Poor	70.00	20.00	6.00	2.00	98.00
A8MV	" "	Medium	70.00	20.00	6.00	2.00	98.00
A8WV	" "	Well	70.00	20.00	6.00	2.00	98.00

Actual stand basal area per acre was compared with 57% full stocking basal area on a percentage basis. This percentage for each stand was applied to the full stocking mean annual growth at rotation age. The result is a representative annual growth - the growth that can be expected for that stand at its present stocking level. This annual growth figure was multiplied by the number of acres in the stand. Totals for all stands were summarized to arrive at the periodic annual growth. Details of the calculation are presented in Table Number 18.

Periodic annual growth by timber type in each working group is shown in Table Number 19.

This growth data is an estimate only. It is weak because of the limited site information and the lack of information about the residual cubic foot volumes for each timber type. As more data is gathered through compartment inventory and planning, a revision of this growth summary can be made.

Table 18. Calculation of Periodic Annual Growth - Sacramento Working Circle, Lincoln National Forest

Timber Type	Stocking Class in % of Crown Cover	Acres 110 yr. Rotation Age 1/	Acres 200 yr. Rotation Age 1/	Basal Area at Full Stocking Sq.Ft. 2/	57% of Full Stocking Basal Area Sq.Ft.	Actual Basal Area Stocking Sq.Ft. 3/	Percent of Actual to 57% Basal Area 4/	Per Acre Periodic Annual Growth as Derived from Mean Annual Growth 5/ 110 yr. Age Bd.Ft. 210 Mean	Per Acre Periodic Annual Growth as Derived from Mean Annual Growth 5/ 200 yr. Age Bd.Ft. 215 Mean	Working Circle Periodic Annual Growth 110 Yr.Age Bd. ft., Scribner	Working Circle Periodic Annual Growth 200 Yr.Age Bd. ft., Scribner
Ponderosa Pine											
Nonstocked		21,668	651	---	---	---	---	---	---	---	---
Cutover Reproduction	Medium	16	---	70	40	---	---	---	---	---	---
Cutover Poles	Poor	4,652	---	188	107	26.98	25.2	53	---	246,556	---
" "	Medium	7,336	653	188	107	55.32	51.7	109	111	799,624	72,483
" "	Well	231	---	188	107	82.47	77.1	162	---	37,422	---
Cutover Sawtimber	Poor	41,634	---	198	113	49.90	44.2	93	---	3,871,962	---
" "	Medium	1,143	958	198	113	114.30	101.2	210	215	240,030	205,970
Virgin Poles	Poor	1,203	---	188	107	26.98	25.2	53	---	63,759	---
" "	Medium	286	---	188	107	55.32	51.7	109	---	31,174	---
Virgin Sawtimber	Poor	1,706	---	198	113	43.02	38.1	80	---	136,480	---
" "	Medium	138	---	198	113	43.02	38.1	80	---	11,040	---
		80,013	2,262							5,438,047	278,453
		82,275								5,716,500	
Mixed-conifer								242 Mean	264 Mean		
Nonstocked		7,548	87	---	---	---	---	---	---	---	---
Cutover Reproduction	Poor	20	---	76	43	---	---	---	---	---	---
" "	Medium	81	---	76	43	---	---	---	---	---	---
" "	Well	10	8	76	43	---	---	---	---	---	---
Cutover Poles	Poor	2,570	---	165	94	58.77	62.5	151	---	388,070	---
" "	Medium	3,896	469	165	94	65.10	69.3	168	183	654,528	85,827
" "	Well	3,281	---	165	94	95.73	101.8	242	---	794,002	---
Cutover Sawtimber	Poor	52,107	---	233	133	69.47	52.2	126	---	6,565,482	---
" "	Medium	30,400	2,650	233	133	88.59	66.6	161	176	4,894,400	466,400
" "	Well	2,913	---	233	133	117.39	88.3	214	---	623,382	---
Virgin Poles	Poor	207	---	165	94	58.77	62.5	151	---	31,257	---
" "	Medium	2	89	165	94	65.10	69.3	168	183	336	16,287
" "	Well	63	---	165	94	95.73	101.8	242	---	15,246	---
Virgin Sawtimber	Poor	2,141	---	233	133	89.50	67.3	163	---	348,983	---
" "	Medium	1,034	1,047	233	133	78.93	59.3	144	157	148,896	164,379
" "	Well	1,748	---	233	133	117.39	88.3	214	---	374,072	---
		108,021	4,350							14,838,654	732,893
		112,371								15,571,547	
Spruce-fir								242 Mean	264 Mean		
Nonstocked		18	---	---	---	---	---	---	---	---	---
Cutover Sawtimber	Poor	1,138	---	233	133	103.20	77.6	188	---	213,944	---
" "	Medium	492	29	233	133	103.20	77.6	188	205	92,496	5,945
		1,648	29							306,440	5,945
		1,677								312,385	
Aspen								242 Mean	264 Mean		
Cutover Reproduction	Medium	224	---	76	43	---	---	---	---	---	---
" "	Well	17	---	76	43	---	---	---	---	---	---
Cutover Poles	Poor	173	---	165	94	78.91	83.9	203	---	35,119	---
" "	Medium	2,774	---	165	94	78.91	83.9	203	---	563,122	---
" "	Well	3,916	---	165	94	15.24	16.2	39	---	152,724	---
Virgin Poles	Poor	28	---	165	94	46.83	49.8	121	---	3,388	---
" "	Medium	128	---	165	94	46.83	49.8	121	---	15,488	---
" "	Well	722	---	165	94	46.83	49.8	121	---	87,362	---
		7,982	---							857,203	---
		7,982								857,203	
		197,664	6,641							21,440,344	1,017,291
		204,305								22,457,635	

1/ 110 year Rotation Age, 120 year Rotation Period for Technical and Christmas Tree Working Groups.
200 year Rotation Age and Rotation Period for Administrative Working Group.

2/ From Table 4, Technical Bulletin 630, for Ponderosa Pine, Average Site Index 80.
Average Age Reproduction - 20 years.
Average Age Poles - - - - 45 years.
Average Age Sawtimber - - 105 years.

From Table 2, Technical Bulletin 201 for Mixed-conifer, Spruce-fir, and Aspen, Average Site Index 100.
Average Age Reproduction - 20 years.
Average Age Poles - - - - 50 years.
Average Age Sawtimber - - 105 years.

3/ From Stand Tables compiled from inventory data.

4/ Actual basal area stocking divided by 57% of Full Basal Area Stocking.

5/ Mean Annual growth for Ponderosa Pine from Table 25, Technical Bulletin 630, Average Site Index 80.
Mean Annual growth for Mixed-conifer, Spruce-fir, and Aspen, computed from Table 4, Technical Bulletin 201, Average Site Index 100.
Anticipated periodic annual growth per acre determined by multiplying the actual percent of basal area stocking by the mean annual growth.

Table 19. Periodic Annual Growth by Working Group - Sacramento Working Circle - Lincoln National Forest

Timber Type	Stocking Class in % of crown Cover	Technical Working Group		Christmas Tree Working Group		Administrative Working Group	
		Acres	Growth Bd. ft.	Acres	Growth Bd. ft.	Acres	Growth Bd. ft.
Ponderosa Pine							
Nonstocked		21,668	---	---	---	651	---
Cutover Reproduction	Medium	16	---	---	---	---	---
Cutover Poles	Poor	4,652	246,556	---	---	---	---
" "	Medium	7,336	799,624	---	---	653	72,483
" "	Well	231	37,422	---	---	---	---
Cutover Sawtimber	Poor	41,634	3,871,962	---	---	---	---
" "	Medium	1,143	240,030	---	---	958	205,970
Virgin Poles	Poor	1,203	63,759	---	---	---	---
" "	Medium	286	31,174	---	---	---	---
Virgin Sawtimber	Poor	1,086	86,880	620	49,600	---	---
" "	Medium	138	11,040	---	---	---	---
		79,393	5,388,447	620	49,600	2,262	278,453
Mixed-conifer							
Nonstocked		7,548	---	---	---	87	---
Cutover Reproduction	Poor	20	---	---	---	---	---
" "	Medium	81	---	---	---	---	---
" "	Well	10	---	---	---	8	---
Cutover Poles	Poor	2,570	388,070	---	---	---	---
" "	Medium	3,896	654,528	---	---	469	85,827
" "	Well	3,281	794,002	---	---	---	---
Cutover Sawtimber	Poor	52,107	6,565,482	---	---	---	---
" "	Medium	30,400	4,894,400	---	---	2,650	466,400
" "	Well	2,913	623,382	---	---	---	---
Virgin Poles	Poor	207	31,257	---	---	---	---
" "	Medium	2	336	---	---	89	16,287
" "	Well	63	15,246	---	---	---	---
Virgin Sawtimber	Poor	2,141	348,983	---	---	---	---
" "	Medium	466	67,104	568	81,792	1,047	164,379
" "	Well	---	---	1,748	374,072	---	---
		105,705	14,382,790	2,316	455,864	4,350	732,893
Spruce-fir							
Nonstocked		18	---	---	---	---	---
Cutover Sawtimber	Poor	1,138	213,944	---	---	---	---
" "	Medium	492	92,496	---	---	29	5,945
		1,648	306,440	---	---	29	5,945
Aspen							
Cutover Reproduction	Medium	224	---	---	---	---	---
" "	Well	17	---	---	---	---	---
Cutover Poles	Poor	173	35,119	---	---	---	---
" "	Medium	2,774	563,122	---	---	---	---
" "	Well	3,916	152,724	---	---	---	---
Virgin Poles	Poor	28	3,388	---	---	---	---
" "	Medium	128	15,488	---	---	---	---
" "	Well	722	87,362	---	---	---	---
		7,982	857,203	---	---	---	---
Working Circle Totals		194,728	20,934,880	2,936	505,464	6,641	1,017,291
Grand Totals		204,305	22,457,635				

d. Estimate of Periodic Annual Growth for Period July 1, 1981 to June 30, 2001

The residual growing stock will be increased by approximately 262,920 M bd. ft., Scribner, during the cutting period July 1, 1961 to June 30, 1981. This should raise the level of stocking from 56% of optimum to 83% of optimum.

Periodic Annual growth for this period can be expected to be 83% of mean annual growth or 38,941 M bd. ft., Scribner.

F. Fire Statistics Summary

Table 20. Fire Statistics - Lincoln National Forest

Year	Number of Fires by Size Class					Number of Fires by Causes			Acres Burned
	A	B	C	D	E	Lightning	Timber	Other Man-Caused	
1960	73	13	4			58	1	31	137
1959	81	10	4			58	3	34	89
1958	61	4				54		11	13
1957	56	6	1			56	1	6	95
1956	86	16	2	1	2	81	1	25	6,714
Total									7,048

Largest timber fire caused by timber operator Harvey - 582 acres - February 1956 - was on Harvey's private land under Forest Service protection.

Average 1 timber operator fire per year.

Average 1,410 acres burned per year.